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Machining the Gear-Shaper Saddle

By DOUGLAS T. HAMILTON
The Fellows Gear Shaper Co., Springfield, Vt.

Accurate machine work can only be produced by accurate tools. Just as a chain can be no stronger than its weakest link, so a piece of work can be no more accurate than is the machine that produces it. Interchangeability of parts in machine tools requires work of the highest accuracy.

WITH the exception of the index wheel and worms, the gear-shaper saddle, shown completely machined in Fig. 1, requires the most accurate machining of any other member of the gear wheel and worm. The cutter spindle must be held in perfect alignment with the work spindle; it must run absolutely true, and its relation to the other members must be accurately maintained as the saddle is adjusted

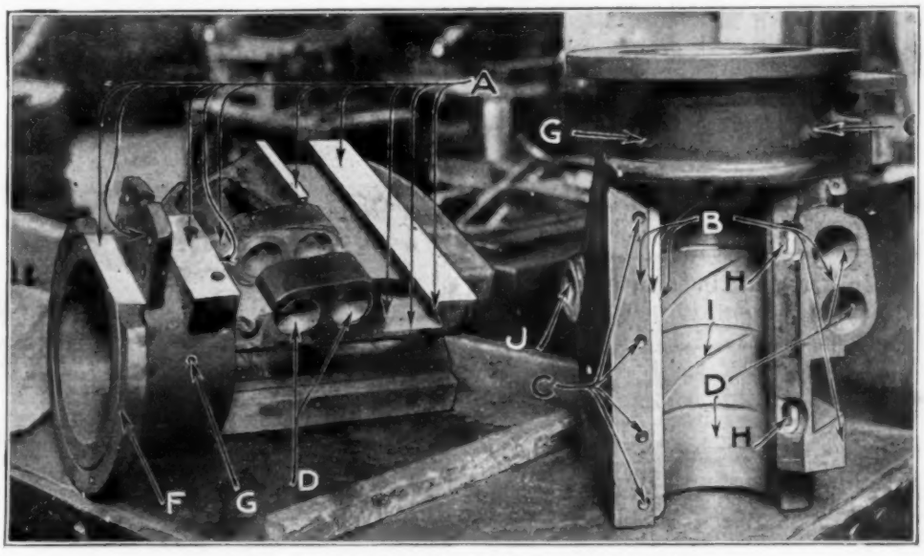


FIG. 1. COMPLETELY MACHINED SADDLE

shaper. The saddle not only carries the cutter, cutter slide, and cutter spindle, which holds and controls the action of the cutter, but also contains the upper index along the bed for cutting gears of different diameters. In view of these many exacting requirements, the gear-shaper saddle represents an excellent example of inter-

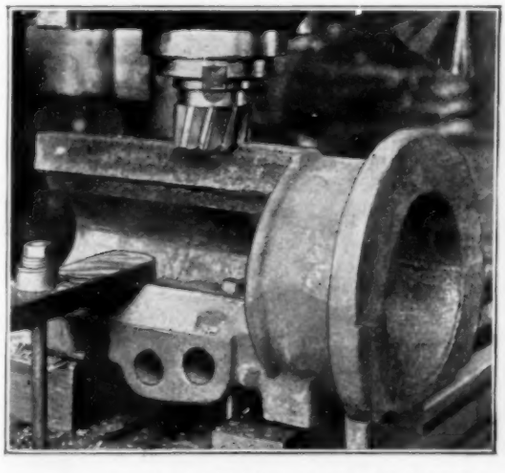


FIG. 2. MILLING FRONT FACE AND SPOT POINT USED FOR LOCATING SADDLE FOR PLANING

FIG. 3. GENERAL VIEW SHOWING SIX SADDLES HELD IN SPECIAL FIXTURES FOR COMPLETE PLANING

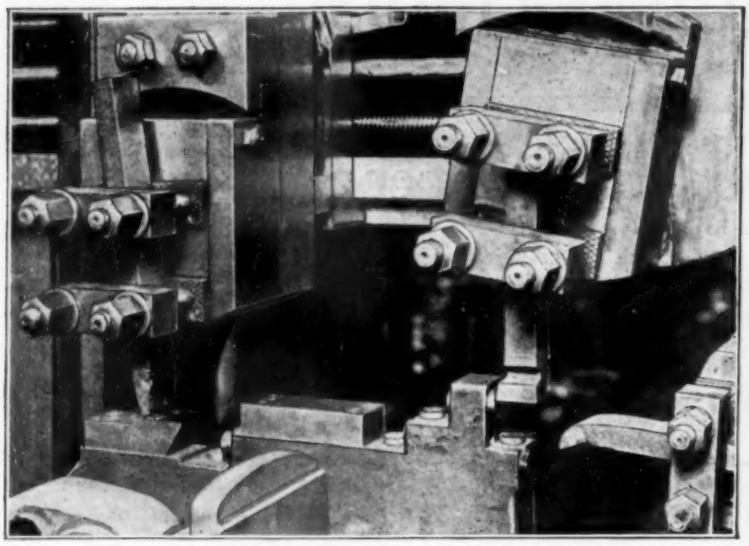


FIG. 4. TOOL SETTING BLOCKS USED FOR SETTING, ROUGHING AND FINISHING TOOLS ON PLANER

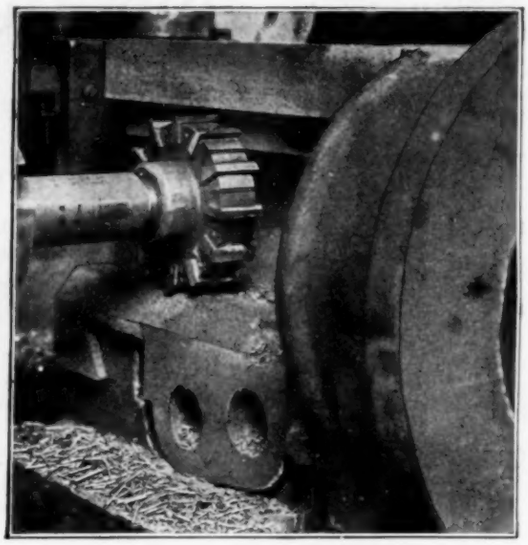


FIG. 5. MILLING GEAR-SHAPER SADDLE

changeable manufacture as applied to the production of a highly accurate machine tool.

The preliminary operations on the saddle are not unusual, and consist in snagging and smoothing down the casting with a portable grinding wheel. It is then brought to a milling machine (see Fig. 2), where two spots are milled, one being the front surface which is finished at this time. These two spots are used for locating the saddle in the first important operation, which consists in planing the entire saddle on those surfaces, marked *A* in Fig. 1.

The planing of the gear-shaper saddle is done very expeditiously. Six castings, as shown in Fig. 3, are held at one time on special jigs, clamped to the platen of the planer. Roughing and finishing cuts are taken from all surfaces marked *A*, Fig. 1, and for setting the tools, tool-setting blocks are used, as illustrated in Fig. 4. By means of these hardened and ground blocks, and a feeler, the operator can set the tools very accurately.

The planing operations on this saddle are as follows: Set the three tools, shown in Fig. 4, for the rough planing operation. Set tools for finish planing straight surfaces. The platen is then cleaned, the clamps on the fixtures released and the fixtures adjusted for planing the taper for the gib. In Fig. 3 it will be noticed that the fixtures are made with a flange which extends below the top surface of the platen. The flange on the left-hand side is parallel with the travel of the platen;

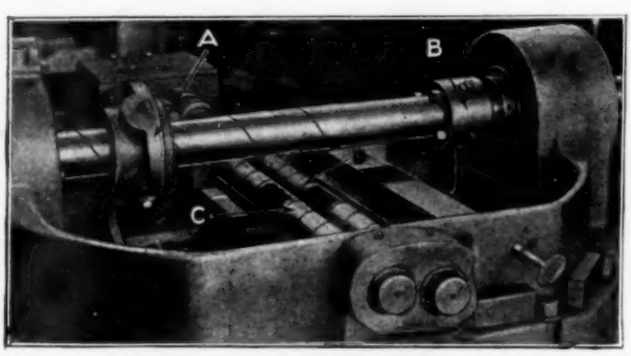


FIG. 8. FIXTURES AND BORING BARS USED ON MACHINE ILLUSTRATED IN FIG. 7

whereas the one on the right side is at an angle. For the taper planing for the gib, this angular flange is brought in contact with the side of the planer platen.

After the fixtures are clamped, the taper way is then rough- and finish-planed, the tools being set with

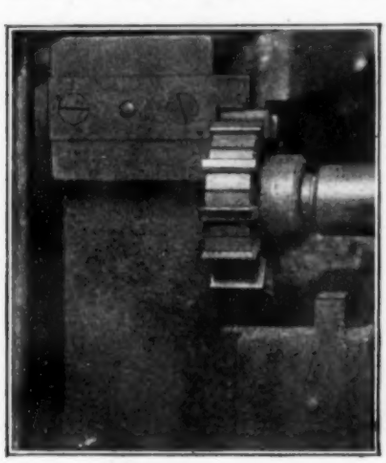


FIG. 6. TOOL SETTING BLOCKS USED ON MILLING MACHINE ILLUSTRATED IN FIG. 5

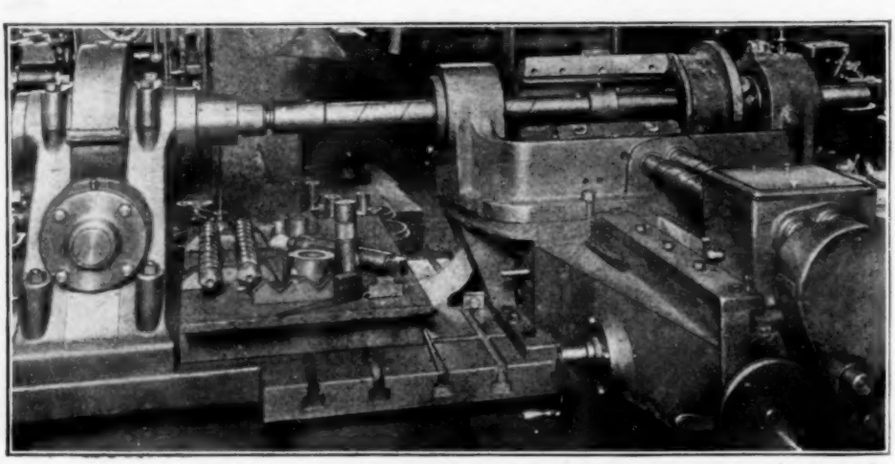


FIG. 7. GENERAL VIEW OF TWO-HEAD SPECIAL BORING MACHINE USED FOR COMPLETING ALL IMPORTANT BORING OPERATIONS ON SADDLE

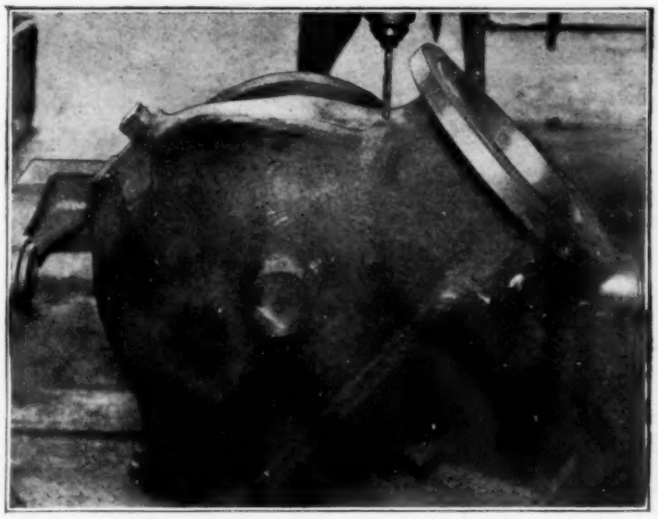


FIG. 9. TRUNNION JIG USED IN HOLDING SADDLE WHILE DRILLING THE OIL AND NAME-PLATE HOLES

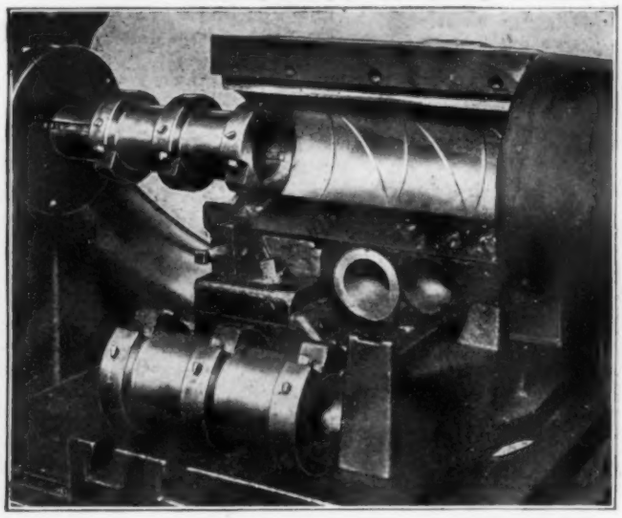


FIG. 10. CLOSE VIEW SHOWING SPECIAL THREE-TOOL HEAD USED IN CUTTING SPIRAL OIL GROOVES IN SADDLE

setting blocks. The ways are now tested for accuracy with a gage before removing from the fixture. The total planing time is 54 minutes for each saddle.

Following the planing operation, the saddle is taken to the horizontal milling machine, shown in Fig. 5, where those surfaces, marked *B* in Fig. 1, are completed. The work from now on is located from the ways or guide in the saddle from which point it is finally located on the bed. Every jig from this point on until the saddle is complete is really a duplicate of a section of the bed, and the saddle is clamped up against the same surfaces that it will rest upon when it is assembled in the complete machine.

Fig. 6 shows a close view of the special fixture used in holding the saddle while the surfaces *B*, Fig. 1, are machined. The operations are: Place saddle in fixture and clamp. Mill for taper gib, see point on setting gage, Fig. 6, rough and finishing cuts, setting milling cutter to tool-setting blocks. Mill out seat for back-gib; mill top of taper; mill face of rock-shaft boss and face for lead-screw bushing; mill face; unclamp and remove from fixture. Following this operation, the holes for clamping the front gib, which are marked *C*

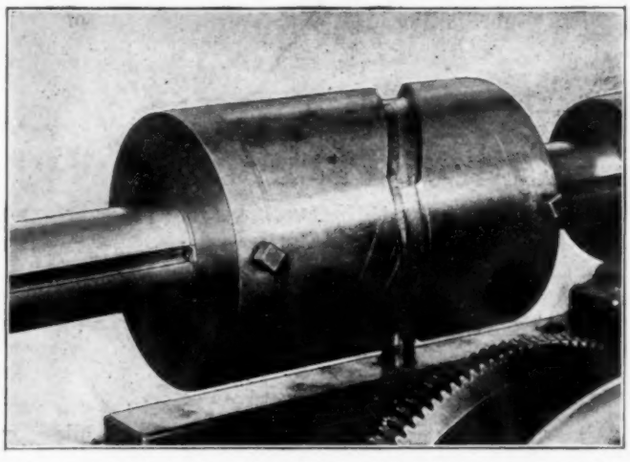


FIG. 11. SHOWING CAM THAT OPERATES THREE-TOOL HEAD FOR CUTTING OIL GROOVES

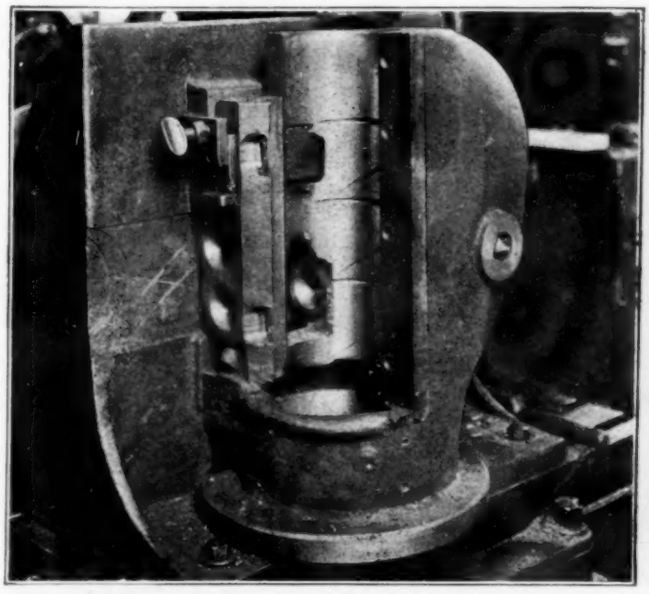


FIG. 12. FIXTURE USED FOR DRILLING, BORING AND REAMING SADDLE PINION-SHAFT HOLE

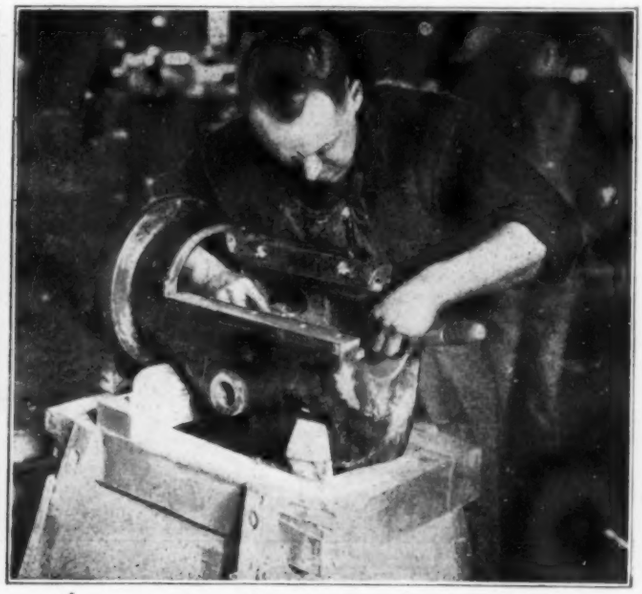


FIG. 13. SCRAPING BEARING FOR CUTTER SLIDE IN SADDLE

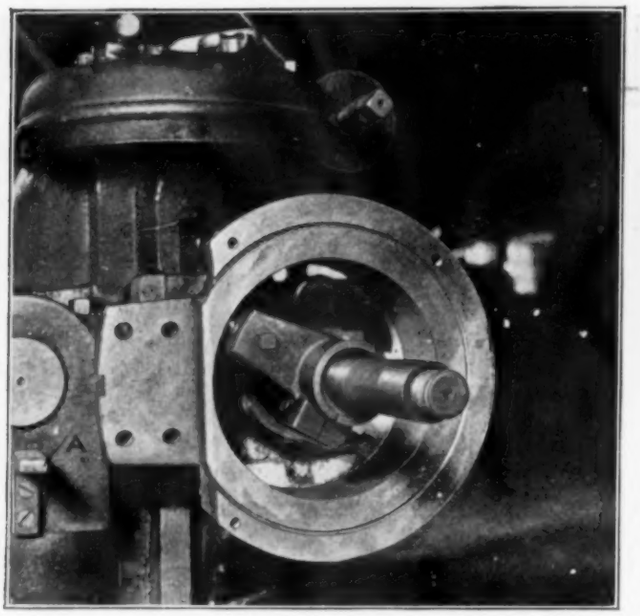


FIG. 14. SPECIAL FIXTURE FOR RE-BORING AND RE-FACING INDEX-WHEEL HOUSING BEARING AND SEAT

in Fig. 1, are drilled in a radial drilling machine.

The boring operations on the saddle are handled on a special two-head horizontal boring machine having arrangements for driving three boring spindles. The general arrangement of this machine is illustrated in Fig. 7, where the saddle is shown being machined in place. Fig. 8 shows the fixture with the saddle removed and illustrates how the various boring-bars are held and supported; also, the method of locating and clamping work. It will be noticed here that the locating points in the fixture resemble in form, a section of the gear-shaper bed.

The operations performed at this setting are: Place saddle in fixture and clamp; rough-bore for upper index-wheel housing, using head *A*, Fig. 8; rough-bore for cutter slide, using toolhead *B*; chamfer end of cutter-slide bore using a tool that is inserted in head *B*. The roughing heads *A* and *B* are now removed, and finishing heads substituted.

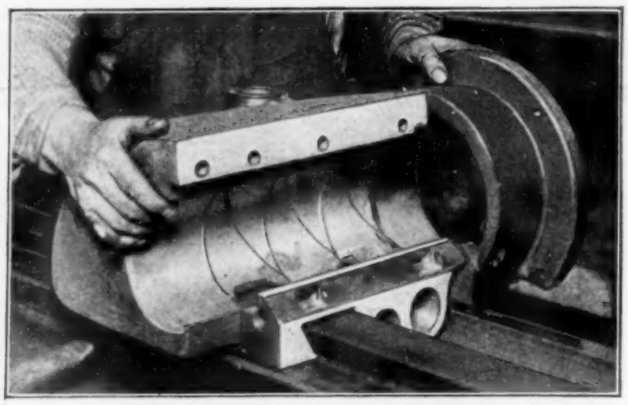


FIG. 17. SCRAPING SADDLE TO MASTER BED

The second boring cut is now taken for the upper index-wheel housing; bore for rock-shaft and lead screw, using bars *C* and *D*, and at the same setting take second cut on cutter-slide bore. Remove heads, and finish-bore for upper index-wheel housing, and at the same setting face seat for rock-shaft gear. Finish cutter-slide bore and face other seat for rock-shaft gear bring boss to length. Face inside of lead-screw hole to gage; unclamp, remove work and clean out fixture. Then ream lead-screw and rock-shaft holes by hand. The various surfaces in this operation are indicated by *D* in Fig. 1.

Drilling Operations

Now follows a series of relatively unimportant drilling operations which are handled on a radial drilling machine. Following this, the flange and oil groove, *F*, Fig. 1, are machined in a horizontal boring machine. Then the oil and name-plate holes, *G*, Fig. 1, are drilled in a special rotating jig shown in Fig. 9. The elongated holes, *H*, Fig. 1, for the setscrews for the gib are now machined in a hand-milling machine.

Cutting Spiral Oil Grooves

The spiral oil grooves, *I*, Fig. 1, in the saddle, for furnishing lubricant to the cutter slide, are now cut in a special machine, which is illustrated in Figs. 10 and 11. Fig. 10 shows the special three-tool head used

FIG. 15. TESTING TRUTH OF INDEX-WHEEL HOUSING BEARING WITH CUTTER SLIDE AND CUTTER SPINDLE

FIG. 16. TESTING TRUTH OF SEAT ON SADDLE FOR WORM-WHEEL HOUSING WITH RELATION TO CUTTER SLIDE AND CUTTER SPINDLE

in cutting the oil grooves; whereas Fig. 11 shows the barrel cam that controls the action of the oil-grooving tools. In this same setting, a clearance cut, eccentric to the cutter-slide bore is made so as to relieve a portion of the bearing of the cutter slide in the saddle.

Drill, Bore and Ream Pinion-Shaft Hole

The next operation, which consists in drilling, boring and reaming the hole for the bevel pinion shaft, *J*, Fig. 1, that is used in adjusting the saddle along the bed, is performed on a special horizontal boring machine, illustrated in Fig. 12. The saddle is located from the ways upon which it rests, when assembled on the bed. The clamping spot mentioned in connection with the first milling operation is now removed, after which the saddle passes to the assembling department.

The first operation in the assembling department is really a hand-fitting one, and consists in scraping the

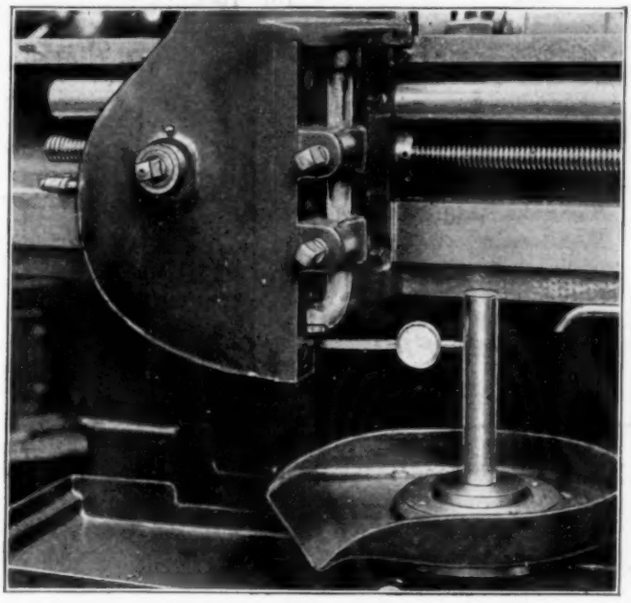


FIG. 18. TESTING ALIGNMENT OF WORK AND CUTTER SPINDLES

cutter-slide bearing. Owing to the fact that the cutter slide is reciprocated twice for every cut taken, it is highly essential that it shall have a perfect bearing in the saddle in order that it may have a long life and run with extreme accuracy. For this reason, great care is taken in scraping the saddle seat for the cutter slide.

For the scraping operation, the saddle is held in a cradle, so that it can be swung to various positions, as indicated in Fig. 13. The cutter slide is ground all over and is machined to very close limits, but, as has been previously explained, the fit of the slide in the saddle is a vital point, so that each saddle is scraped to a cutter slide which will finally be assembled in it.

An operation which illustrates very clearly the pains taken to secure accuracy is illustrated in Fig. 14. This shows the boring of the seat for the upper index-wheel housing. The saddle is held on a special fixture resembling in form a section of the bed, the cutter slide and cutter spindle which will be assembled with it are put in place; on the cutter spindle are clamped special boring heads used in boring and facing the seats for the index-wheel housing.

The boring-head is driven from a driving arrangement connected to the cutter spindle through a universal joint. Two boring cuts are taken. Then the head is changed and two cuts are taken from the top flange or seat. The facing head, not illustrated, carries a screw and star feed, which is operated by the projection *A* on the fixture, as the head rotates.

As an indication of the accuracy obtained, it might be stated that the bore seldom, if ever, runs out more than 0.0015 in. before the finish-boring operation, so that this final boring operation secures concentricity to as close limits as is possible by the best-known machining methods.

Testing for Accuracy

The operations from now on consist in scraping, fitting and testing. Fig. 15 illustrates how the bore for the index-wheel housing is tested for concentricity. In this same setting the guide is held on the cutter-spindle and is tested and scraped to a bearing in the index-wheel housing, the latter being fitted in the saddle.

Fig. 16 shows how the top surface is tested with a dial indicator for truth relative to the cutter-spindle and index-wheel housing. It is also scraped at this setting to a bearing.

The final scraping operation is illustrated in Fig. 17, and consists in scraping the ways in the saddle to a bed whose plane surfaces have been accurately scraped. This insures interchangeability of saddles and beds.

The final testing operation is made when the machine is completely assembled, and is done as illustrated in Fig. 18. A dial indicator is clamped to the cutter spindle; an accurately ground arbor placed in the work spindle and the parallelism of these two members tested. A maximum tolerance of 0.001 in. in 5 in. is permitted.

In addition to the refinements in machining, the completed machine is tested under actual power for five hours' steady running. Every machine also must produce an accurate gear before it is permitted to leave the plant.

What Is a Machine Tool?

By E. Lytton-Brooks

In reply to the query of F. J. Deacon on page 548, vol. 52 of *American Machinist*, with regard to "What Is a Machine Tool?" I hardly think a true definition of this class of tool can be found in any dictionary. The definitions given are generally very vague or elusive, sometimes accompanied by little sketches or blocks of the machine itself usually copied from a type many years obsolete. The dictionary, no matter how modern, seldom keeps up to the times in mechanical matters and a good reference book on up-to-date tools is more likely to give a fairly accurate description.

I have always been given to understand that a machine tool was one which incorporated at least one purely mechanical movement and performed an operation with a tool by this mechanical movement. Say a lathe with an automatic traverse: the fact that the machine is capable of operating or removing material unaided, or taking care of itself until that operation is concluded, constitutes a machine tool. I should think that any machine that moves the tool or the work in any plane and at the same time causes the work to be operated upon definitely under its own mechanical movement and temporary control could be classed as a machine tool no matter what material is operated on.

An Experimental Investigation of Steel Belting—I

BY F. G. HAMPTON, C. F. LEH, AND W. E. HELMICK
STANFORD UNIVERSITY, CAL.

(*From Mechanical Engineering, July, 1920*)

At the annual meeting of the American Society of Mechanical Engineers, held Dec. 2 to 5, 1919, in New York, Student and Junior prizes were awarded to the authors of the following paper. It treats of an investigation undertaken by them at Leland Stanford University as a partial requirement for the degree of engineer. Part I was written by Messrs. Hampton and Leh in 1918, and Part II by W. E. Helmick the year following. The first section deals with a description of the apparatus employed, the character of the belting, and a discussion of the results obtained in investigating the coefficients of friction and velocity of slip.

ATTENTION has been called from time to time to the successful use of thin ribbons of steel for belting, and the purpose of the experimental work herein described was to determine, as far as time would permit, the characteristics of operation and the general laws controlling the performance of this means of power transmission. The literature on the subject of steel belts is very limited, and so far as is known there has been little or no experimental work done.

The controlling features of the design of an apparatus for testing steel belting may be enumerated as follows:

1. The machine must be so constructed that very high speeds may be obtained, and also means provided to vary the speed over as large a range as possible.
2. Since very high efficiencies are expected, it is necessary to provide means for measuring accurately the losses of power which occur in the belt.
3. The apparatus must be so constructed that the tensions in the tight and loose sides may be accurately determined.
4. On account of relatively small slip it is necessary to provide specially constructed apparatus to accurately determine this variable.
5. For the sake of convenience it is necessary to have the machine built so that belts can be changed easily and different lengths used.

DESCRIPTION OF APPARATUS

Two special high-speed pulleys were constructed upon which the belt to be tested was run. Since the speed at which cast iron can be safely run is far below that which was desired, it was necessary to select a stronger material and so construct the pulleys that they could be faced with some material other than steel. The pulleys used were built in the department shops by the authors and consisted of two boiler-plate disks, a cast-iron hub, and a wooden rim. The pulleys were made relatively large in order that high peripheral speeds could be obtained with relatively low shaft speeds. The facing consisted of sheet cork, which was chosen as the best material on account of the friction properties and its durability. One of these pulleys, which was to be the driven pulley of the machine, was keyed directly to the shaft of a 100-hp. Sprague dynamometer (see Fig. 1), which was used in testing only as a means of absorbing the power delivered to the driven pulley, and, although record was kept of the readings of the dynamometer, they were only used as a check and did not enter into the calculations of the test.

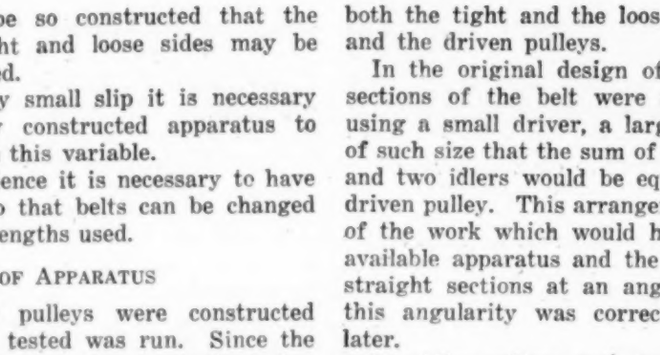


FIG. 1. DIAGRAMMATIC SKETCH OF STEEL-BELT TESTING MACHINE

The other pulley, the driver, was mounted on a short countershaft held in two bronze bearings which were cast and finished specially for the purpose, the bearings being held in a pair of standard shaft hangers which were bolted to the frame. This shaft carried the driver pulley on one end, and on the other end the pulley with which the shaft was driven by a motor through a leather belt.

In order to measure the tensions in both sides of the steel belt, two special idlers were hung behind the driver in such a way that each one completely reversed the direction of the belt on both the tight and the loose sides between the driver and the driven pulleys.

In the original design of the machine the straight sections of the belt were all to be kept parallel by using a small driver, a large driven pulley and idlers of such size that the sum of the diameters of the driver and two idlers would be equal to the diameter of the driven pulley. This arrangement was discarded because of the work which would have been necessary on the available apparatus and the belts were run with their straight sections at an angle. The manner in which this angularity was corrected for will be discussed later.

The idler pulleys were hung on swinging frames so that they were free to swing in the plane of middle of the driver and driven pulleys' faces, but were constrained from moving in any other direction. They were carried on short shafts with high-grade ball bearings in order that friction would be reduced to a minimum. The design of these pulleys was also controlled by the high speed at which they were expected to run, and it was necessary to use a stronger material than cast iron.

Castings were made which formed the hub and a thin, solid web, and rims were made by cut-

ting sections from a piece of heavy lap-welded 10-in. pipe. The castings and steel rings were finished all over, the proper allowance being made for a shrink fit, and the rims heated and shrunk on to the webs, after which they were again machined all over and accurately balanced.

Since it was not considered desirable that the steel belt come in contact with the steel surface of the idlers, even though slippage at this point would be very improbable, the pulley faces were covered with the same variety of sheet cork that was put on the large pulleys.

Throughout the test no trouble was encountered with the cork faces of either the idler pulleys or the large pulleys, and, although speeds as high as 12,000 ft. per minute were attained, there seemed to be no tendency for the cork to fly off.

In order that the pull exerted by the belt on the idlers could be accurately measured, yokes were put on the idler shafts around the idlers, and to these were attached link chains which passed horizontally over ball-bearing sprockets so that, when the swinging frames were in their normal position, the chains were tangent to the arc of their swing and in the same plane. The chain from the idler, over which the tight side of the belt passed, hung vertically downward after passing over its sprocket, and on it was suspended a stem with a plate on its lower end and upon which weights could be placed. The chain from the other idler extended vertically upward after passing over its sprocket, and was attached to the lower part of a dial balance which measured the pull on the loose-side idler.

After starting the test it was found necessary to introduce some kind of a shock absorber to reduce the vibration of the needle on the dial balance, and for this purpose a spring balance of 200 lb. capacity was used. It was also necessary to adjust the length of this chain on account of the variations arising from difference in tension, and to do this a turnbuckle was put in between the dial and spring balances.

The swinging frames, guides, sprockets, and the dial balance were all carried on a rigid superstructure composed of iron bars and angles, and this was firmly bolted to the same I-beams which carried the shaft hangers holding the countershaft, and also the driving motor, so that there could be no relative movement between the various parts of the assembly.

The bedplates which supported this unit consisted of two 8-in. I-beams 16 ft. long, which were set at right angles to the shaft of the Sprague dynamometer and firmly bolted to the floor and shimmed with neat cement. These bedplates formed a guide upon which the driver unit was supported so that this part of the apparatus could be easily moved along the bedplate to accommodate belts of various lengths and without having to disturb the relations between the several elements of the unit.

The motor which was used to supply the driving power was a variable-speed, three-phase induction motor with speeds of 600, 900, 1,200, and 1,800 r.p.m., and rated at 4, 6, 8, and 12 hp. for these respective speeds. The motor was mounted on an adjustable base so that the leather belt driving the countershaft could be tightened, and the controller was mounted on the sliding frame near the motor.

The motor, which is of the most desirable type for the purpose, was not nearly large enough, and as a consequence the range of experimentation was limited by the available power supply and not by the transmission properties of the steel belt as it should have been.

Since it was necessary to make as accurate a determination as possible of the slip which occurred in the belt at all times, two similar devices were made which would electrically control two speed counters, one mounted on the center of the driver shaft and the other on the driven shaft. Two Veeder revolution counters were used for this purpose, being fixed to the shafts so that their spindles rotated on the same centers as that of the shaft; the remainder of the counter floating on the spindle and remaining stationary. On the stationary part was suspended a bar which carried an electromagnet so arranged that when current passed through the coils the movement of the armature would actuate a small lever, which slid the floating part of the counter axially so as to engage the dog clutch and count the revolutions of the spindle. Springs returned the counter to the original position and disengaged the clutch when the circuit was opened.

This arrangement gave a fairly accurate measure of speed because both instruments were made alike; and since the coils were in the same circuit and the springs of the same strength, it should give very dependable results. The difficulty, however, was not in the determination of the absolute speed, but of the difference of speed, and, since the counters only registered to the nearest revolution and the clutches were only two-jaw clutches, there is a possibility and also a probability of an error of one revolution either way, or two revolutions, and when the slip is small, say only 2 r.p.m., may involve an error in slip of 100 per cent, although the error involved in determining absolute speed is only a very small fraction of one per cent. In order to make accurate measurements of slip, it is evident that a differential counter should be used of such design that it would record to at least 0.10 r.p.m.

The entire testing apparatus as herein described is in itself a transmission dynamometer which measures its own losses. Having measured the tension in both the tight and the loose sides of the steel belt, and the peripheral velocity of both driving and driven pulleys, the power delivered to the driving end of the belt may be computed from the value of the net pull, which is the difference between the two belt tensions and the peripheral speed of the pulley face. In a similar manner the power delivered to the driven pulley may be computed from the net pull and the peripheral velocity, the tension in the belt being uniform between pulleys, and the friction or slippage losses may be obtained from the net pull and the velocity of slip.

It is assumed that no work is done or power consumed in bending the belt, and this assumption is substantiated by the fact that the material is perfectly elastic within the limits worked, and whatever power is required to bend the belt is given back to the system when it returns to its normal condition.

In order to further verify this assumption, pieces of the belting were caused to vibrate at a very high rate of speed by holding them on the teeth of a rapidly turning sprocket. Had there been any appreciable internal friction losses present there would have been a noticeable rise in temperature in the part of the steel which was subjected to such rapid bending. Although the pieces became warm at one end from the friction of contact with the sprocket, and on the other end from

impact on the material with which they were held, the part which was subjected to the severest bending remained cool.

This leaves the only losses sustained in transmitting power by steel belting to be those due to slippage of the belt on the cork surface, and since this can be reduced to practically nothing by increasing the belt tension, it appears that practically 100 per cent transmission efficiency may be obtained. The experimental results consistently verify this statement.

Belt Material and Correction for Angularity

The material which was used for the steel belts in this work was what is known in the commercial world as clock-spring. It is very high carbon steel drawn and rolled, apparently ground to size, hardened, and drawn to a dark-blue color. A rough test showed a tensile strength of slightly over 300,000 lb. per square inch and an elastic limit nearly as high. The material in pieces 0.01 in. thick receives no permanent set when bent around a radius of $\frac{1}{2}$ in. and snaps with a clean break when bent around a radius of $\frac{1}{16}$ in.

The chief difficulty in using such material for belting is to get a joint which will develop a sufficient proportion of the strength of the material. Considerable work was done in this connection, and, although no prediction of the durability of the joints used can be made, on account of the short duration of the test, they proved to be entirely satisfactory within the limits used, and under conditions which were probably more severe than would be found in an actual commercial installation.

Because of the arrangement of the pulleys, and the consequent reversal of the curvature which any part of the belt receives when passing over them, it was impossible to use the standard fastening, which consisted of a strap of a curvature equal to the smallest pulley and to which the two ends of the belt were made fast by means of screws or rivets. A later discussion of the subject of joints will describe the various ones used and show why the plain butted joint held with silver solder was the best one for the purpose.

In order to correct for the angularity of belt pull on the idler pulleys and its effect upon the readings of the dial balance and the dead weights, a method was used which calibrated the exact belt tension directly against the readings of both the dial balance and the dead weights.

A belt was put on which, instead of being spliced, had its two ends joined by a link composed of a turnbuckle and an accurate spring balance. Weights were put on the hanging platform, the swinging arms brought to their normal positions by adjusting the turnbuckle below the dial balance, and readings were taken of the dial balance and the spring balance while slowly rotating the driven wheel first in one direction and then in the other. This method divided the friction, and the average of the two readings gave the true readings which could be plotted against one another and a curve drawn from which the true belt tension could be read for any reading of the dial balance or the dead weights.

On account of the limited time it was only possible to cover a small portion of the work necessary for a complete test of steel belting, and accordingly the field in which speed, horsepower, and tension are the chief variables was selected for investigation.

A series of runs was made at constant speed and, keeping one value of tension constant, the load was varied from no load to an upper value limited either by the available supply of driving power or by the slippage of the steel belt.

Since the tension in the tight side, T_1, was kept constant over any run, it may readily be seen that for an increase in transmitted horsepower the factor $T_1 - T_2$ could be made larger only by decreasing T_2, and that when this quantity was reduced to a very small value the loose side of the belt would become very unstable. After covering the range of horsepower possible, the tension was changed and another run made with varying horsepower.

Having covered the desirable range of tensions, the speed was then changed and another series of runs at the new speed was made. In making a run, the apparatus was adjusted to operate under conditions of practically no load, the swinging frames on the idlers were brought into their normal position by adjusting the turnbuckles and readings were taken of r.p.m. of driver and driven pulleys, the dial balance indicating the tension in the loose side and the dead weights the tension in the tight side. In timing the r.p.m., 2-min. intervals were used in order to reduce the error due to starting and stopping the counters.

The instruments indicating the other readings were found to be exceptionally constant, and since each reading was checked by both the parties making the run, only one reading for the most part was entered on the log sheets. By taking readings of the Sprague dynamometer beam, data were made available for a calibration of this machine at low capacity values which also served as a rough check on the other readings.

All Instruments Accurately Calibrated

An accurate calibration was made of all the instruments used on the test, including the two spring balances, stop watch, and dead weights. The readings taken can be depended upon to have a high degree of accuracy, with the exception of the difference of r.p.m. in driver and driven pulleys. Since this is a very small value and the error involved is in starting and stopping the counters, the percentage of error in the indication of absolute speed is practically zero.

Since the readings of the tight-side tension were made with weights, they are as accurate as the weights. No difficulty was encountered in reading the dial balance to the nearest pound, and since the idlers were adjusted to their normal position for every change, the readings relative to the belt tensions should be accurate to within 1 per cent.

The arc of contact was measured for each belt length used. As can be seen, when the distance between centers of driver and driven pulleys is varied there will be a slight change in the arc of contact. Since this change was so small and was used only in connection with the value of slip which, as explained before, had a large percentage of error, the change in the arc of contact was not considered.

The following will show how the various values used were obtained from the results of the tests:

Revolutions per Minute. The difference in the readings of the positive speed counters at the beginning and at the end of the timed interval will give the r.p.m. of the driver and driven pulleys, while the difference between the values thus obtained will give the r.p.m. slip.

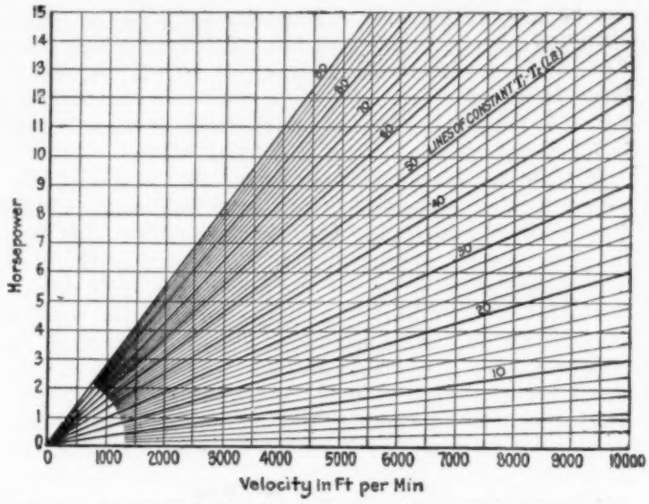


FIG. 2. DIAGRAM FOR COMPUTING HORSEPOWER FROM VELOCITY AND DIFFERENCE IN TENSION

V_s On account of a slight difference in the circumference of the driver and driven pulleys, it was necessary to make a correction. This was made by constructing a diagram from which the velocity of slip could be read directly for any r.p.m. slip and any speed.

V_d The driver velocity is obtained by multiplying the driver r.p.m. by its circumference.

T_1 The tension in the tight side of the belt is read directly from a calibration curve.

T_2 The tension in the loose side is also read directly from a calibration curve.

t_1 The unit tension in the tight side is found by dividing T_1 by the cross-sectional area of the belt, or

$$T_1/0.01 \times 0.75 = T_1/0.0075$$

Driver hp. was obtained from the relation:

$$hp. = \frac{force \times distance\ moved\ per\ min.}{33{,}000} = \frac{(T_1 - T_2)V_d}{33{,}000}$$

A chart was made (Fig. 2) from which the horsepower at any speed or any value of $T_1 - T_2$ may be read directly. This was done by plotting the lines hp. $= KV_d$ for values of K corresponding to the required values of $T_1 - T_2$.

Hp. Loss. This can be obtained from Fig. 2 by using V_s in place of V_d and dividing both horizontal and vertical scales by the same power of ten.

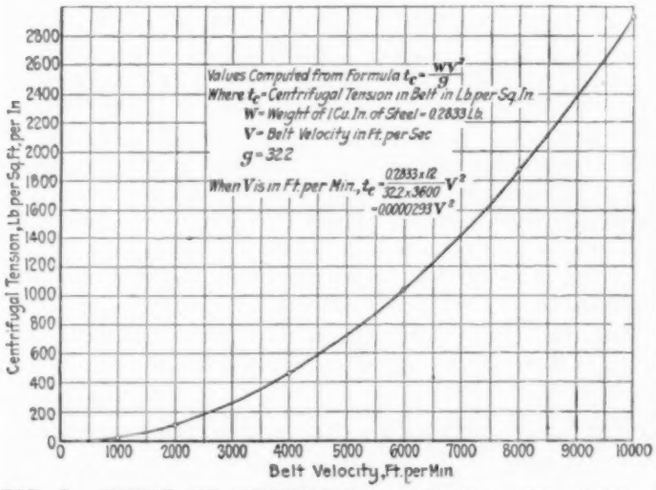

Values Computed from Formula $t_c = \frac{WV^2}{g}$
Where t_c = Centrifugal Tension in Belt in Lb per Sq In
W = Weight of 1 Cu In of Steel = 0.2833 Lb
V = Belt Velocity in Ft per Sec
g = 32.2
When V is in Ft per Min, $t_c = \frac{0.2833 \times 12}{32.2 \times 3600} V^2 = .0000293\,V^2$
Centrifugal Tension, Lb per Sq Ft per In
Belt Velocity, Ft per Min

FIG. 3. CURVE OF CENTRIFUGAL TENSION FOR BELT SPEEDS UP TO 10,000 FT. PER MIN.

Efficiency is computed by taking the ratio of the power input to the belt to its power output:

$$\frac{hp.\ driver - hp.\ loss}{hp.\ driver}$$

t_c The centrifugal tension is determined from the relation:

$$t_c = \frac{WV^2}{g}$$

Fig. 3 shows a plot of this using the proper units and from which t_c for any belt speed may be read.

u The value of the coefficient of friction was calculated from the relation:

$$\log \frac{t_1 - t_c}{t_2 - t_c} = 0.4343\, u\theta$$

where u = coefficient of friction
θ = angle of contact in radians.

Discussion of Results

On account of the uncertainty of the test values of V_s it was first necessary to find, if possible, how this value varied with the others and to discover the law

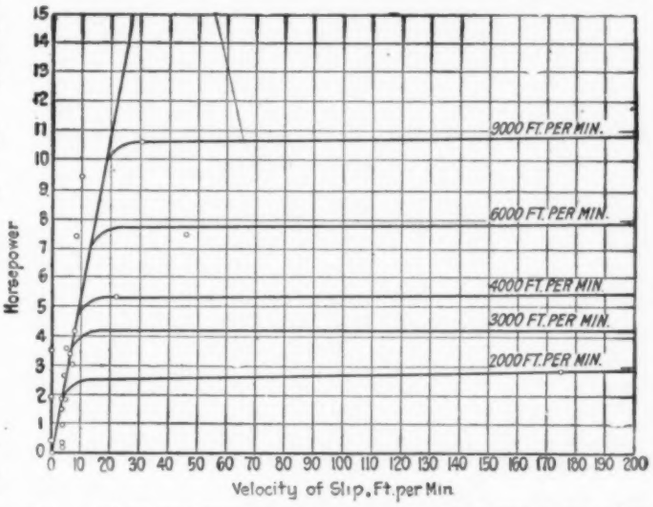


FIG. 4. CURVES SHOWING RELATION BETWEEN VELOCITY OF SLIP AND HORSEPOWER FOR $T_1 = 100$ LB.

which connected its variation with that of other quantities involved. The first step in this process was to plot the test values of V_s against the corresponding values of hp. This was done over the whole range of the test, one sheet for each constant, T_1. Table I and Fig. 4 show results and curves for $T_1 = 100$ lb

After careful consideration of the location of these points, it seemed that the curves for all speeds for any T_1 seemed to follow a straight line beginning at the origin and then to break sharply and leave this line, the point of departure depending upon the speed, and being different for different values of T_1.

It was also noticed that for high values of T_1 the straight line from the origin was much steeper than for lower values. Working on this assumption straight lines were drawn which represented the mean of all points which seemed to locate the line. Although there is a wide variation in the location of these points, it must be remembered that the percentage of possible error in the value of V_s is very large, in fact large enough to justify the moving of practically any of the points to the mean line.

Since it was evident that some simple law existed

TABLE I. DATA AND RESULTS OF TESTS ON 0.75 × 0.01-IN. STEEL BELT (T_1 = 100 LB.)

No. Run	R. p. m. Driver	R. p. m. Driven	Slip ft. per min.	V_d ft. per min.	T_2 lb.	Hp. Driver	Hp. Loss	Eff., per cent	u	V_{sc}
21	243	242	4	2,075	46.0	0.16	0.0002	99.9	0.023	0.1
	242	240	4	2,055	34.0	0.90	0.0008	99.9	0.122	0.3
	240	239	4	2,048	19.0	1.82	0.0031	99.8	0.317	1.7
	238	217	176	2,032	3.5	2.64	0.1200	81.4	.....	44.0
16	364	363	4	3,110	46.0	0.235	0.0001	99.9	0.0246	0.3
	363	361	4	3,090	33.5	1.41	0.0013	99.8	0.127	1.4
	360	359	4	3,080	20.5	2.61	0.0043	99.7	0.303	2.5
	358	357	4	3,060	12.5	3.32	0.0065	89.6	.....	3.0
	357	295	493	3,050	0.5	4.41	0.7200	83.5	.....	246.5
13	485	484	0	4,140	45.5	0.38	0.0001	99.9	0.097	0.4
	480	479	0	4,100	32.5	1.97	0.0022	99.9	0.136	2.3
	476	472	0	4,060	20.0	3.50	0.0057	99.8	0.322	3.1
	466	410	473	3,990	0.0	5.85	0.7000	88.8	.....	227.0
1	727	725	5	6,210	36.2	2.31	0.0010	99.9	0.118	2.1
	723	721	5	6,180	28.5	3.75	0.0035	99.9	0.223	3.5
	715	711	22	6,110	14.5	6.30	0.0089	99.9	0.601	5.8
	709	701	57	6,060	7.2	7.58	0.0706	99.1	.....	10.0
	702	656	358	6,060	2.5	8.37	0.4990	94.1	.....	179.0
	698	607	729	6,060	1.7	8.45	1.0300	87.9	.....	365.0
33	1,102	1,099	8	9,400	33.0	4.31	0.0033	99.9	0.231	3.7
	1,065	1,062	8	9,085	21.5	7.41	0.0105	99.8	0.690	6.5
	1,050	1,047	9	8,905	13.5	9.47	0.0170	99.8	.....	8.5
	972	939	265	8,205	2.5	11.44	0.0570	96.7	.....	128.0

between the various curves, as shown by the change in slope of the main straight line from the origin for different values of tension, values of V_s were plotted against their corresponding values of tension, at constant horsepower. This was done by taking the values of V_s from each curve at 10 hp. and plotting them against the value of tension corresponding to the curve.

The relation as shown from the plot proved to be a very close approximation to a straight line and accordingly the line was assumed and the lines previously located to represent the mean of the plotted points were so changed as to make their inclination to the hp. axis conform to the law. This correction was considered desirable and even necessary on account of the uncertainty in the values of V_s, which has been discussed.

Data were now available for the construction of a characteristic diagram in which lines of constant hp. were laid down on V_s and T_1 axes. (See Fig. 5.) It was noticed on the hp.-V_s curves that there seemed to be some symmetrical relation between the points at which the curves for different speeds broke away from the characteristic straight line. Accordingly, all of these points were transferred to the V_s and T_1 diagrams, the result being a series of surprisingly well-defined lines radiating from very near the origin and cutting the lines of constant hp.

Since the quantity $T_1 - T_2$ is more valuable for use in connection with this work than the quantity T_2, it was found desirable to provide some means of showing the relation of $T_1 - T_2$ to the other variables.

To do this the values of $T_1 - T_2$ were computed for various points on the diagram, and after marking the values in their proper places contours were run so as to show the lines of constant $T_1 - T_2$. The intersections of constant hp. lines and constant-speed lines were used for this purpose and the corresponding values of $T_1 - T_2$ were computed from the following relation:

$$T_1 - T_2 = \frac{33{,}000 \times hp.}{V_d}$$

This diagram may be used in connection with the design of a steel belt within the range of the values used, and applies only to steel belting of the same size as used in the test and run over cork-faced pulleys.

For any belt speed the maximum horsepower which can be transmitted with a given tension and the corresponding velocity of slip and $T_1 - T_2$ can be determined. For instance, if we wish to transmit 10 hp. we have a large range of values of both T_1 and belt speeds from which to make a choice, but when either of these values is fixed, the other assumes a definite value.

It must be remembered in using this diagram that owing to the method of its construction some of the quantities represent not the absolute values, but the limiting values corresponding to the others which have been fixed. Thus if we assume a belt speed of 6,000 ft. per minute with the original assumption of 10 hp. transmitted, it will be seen that T_1 will have a value of about 135 lb. This means that with the conditions which were assumed (10 hp. and 6,000 ft. per minute) any value of T_1 less than 135 lb. would be below the limiting value and that excess slip would be expected. It would be advisable, however, to use a somewhat higher tension, since in this way the velocity of slip would be materially decreased.

On the other hand, if we wished to find what speed would be necessary if we assumed T_1 to be, say, 200 lb., from the diagram it appears that a speed of about

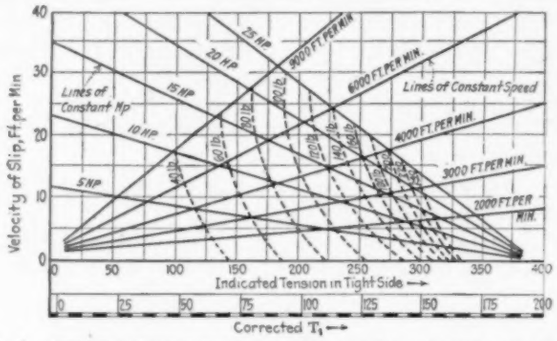


FIG. 5. CHARACTERISTIC DIAGRAM FOR STEEL BELTING

3,600 ft. per minute would be the least speed at which 10 hp. could be transmitted without excess slippage, and at this condition the slip would be about 12½ ft. per minute. Here again it would be advisable to either increase the speed or the tension, in order to work safely below the critical point, because the relations on the diagram represent conditions which correspond to the points on the straight lines of the V_s and hp. curves at which the holding power of the belt on the pulley breaks down and a very great increase in slippage begins.

By extending this diagram to cover a large range of hp., belt velocity and tension, and applying certain coefficients to compensate for changes of belt size and other variables which may occur, a complete working diagram for steel-belt design would be obtained.

The next relation which was wanted was that of the coefficient of friction to the velocity of slip. The method used in calculating these values has been previously explained, the values of V_s used being the corrected values obtained by the method before described.

Fig. 6 shows the curves obtained, and it was found that not only does the coefficient of friction vary with the velocity of slip but also with the belt speed, increasing with increased velocity of slip and with a decrease of speed.

A rather interesting feature was discovered in connection with the computation of the values of the frictional coefficient. In using the quantity

$$\log \frac{t_1 - t_c}{t_2 - t_c}$$

it was found that for some readings the values of $t_s - t_c$ became negative, and hence the expression

$$\frac{t_1 - t_c}{t_2 - t_c}$$

also became negative

Investigation of the curves showed that such values appeared to develop at or near the points where the hp. and V_s curves broke away from their common characteristic line.

Very little can be determined for these values from the experimental data taken, and it is evident that such points are outside of the practical range for the use of steel belting. The phenomenon can, however, be explained as follows:

Whenever the value of t_c became greater than the existing value of t_s, which is the condition under which $t_s - t_c$ is negative, it is evident that there was no force

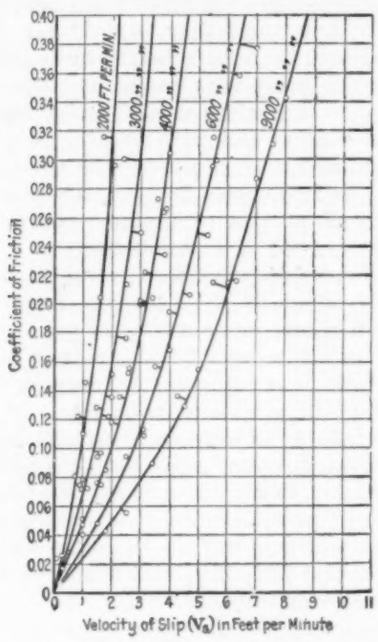


FIG. 6. CURVE SHOWING RELATION BETWEEN VELOCITY OF SLIP AND COEFFICIENT OF FRICTION

acting to keep the belt in contact with the pulley on the loose side. Accordingly, the arc of contact was diminished and conditions brought about which gave rise to the unstable and uncertain conditions which showed up in the experimental work.

In obtaining the values of the coefficient of friction an attempt was made to compute them from the relation:

Ft.-lb. lost due to friction $= u\,p\,r\,\theta\,V_s$

where u = coefficient of friction
p = pressure per unit length of belt on pulley face
r = radius of pulley
θ = angle of contact in radians
V_s = velocity of slip.

Assuming that the total power loss due to friction is also equal to the product of the velocity of slip by the difference in tension

$$(T_1 - T_2)V_s = u\,p\,r\,\theta\,V_s$$

and since

$$p = \frac{T_1 + T_2}{2r\theta}$$

$$V_s(T_1 - T_2) = u\,\frac{T_1 + T_2}{2r\theta}\,r\theta V_s$$

$$u = \frac{2(T_1 - T_2)}{(T_1 + T_2)}$$

Fig. 7 shows the curves plotted from this relation, but on account of their being independent of V_s, values of u were obtained in another manner.

Discussion of Belt Joints

One of the serious difficulties which had to be contended with was the development of some method of joining the ends of the belt in such a way as to develop a fair proportion of the tensile strength of the steel belt and at the same time not to interfere with the smooth operation of the belt and to be of such a nature that the joint will be sufficiently durable.

The following requirements are those which determined the most desirable joint to use:

a In order that there shall be the least possible amount of concentrated strain it is necessary either to have the joint extend along the belt as small an

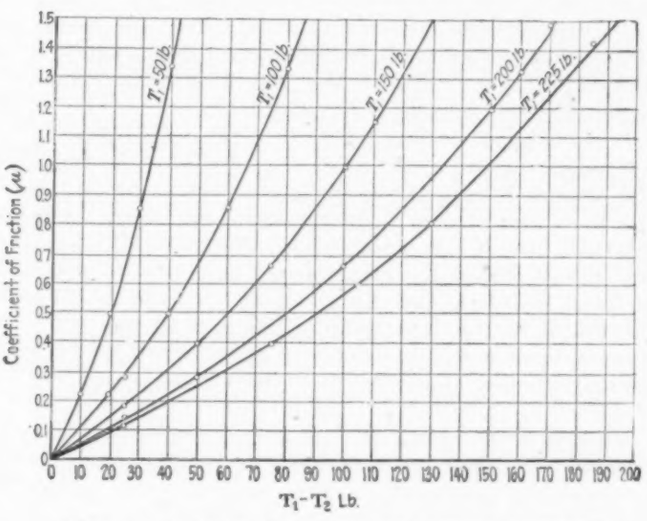


FIG. 7. CURVES SHOWING RELATION BETWEEN COEFFICIENT OF FRICTION AND DIFFERENCE OF TENSION

amount as possible, or to have it so constructed that its flexibility is approximately equal to that of the original belt. If the joint is of such construction that there is a distinct change in the flexibility in adjacent sections the stresses would be so concentrated at the junction point that destructive stresses would cause an early failure of the material.

b On account of the design of the testing machine it was necessary that the joint would be capable of withstanding reversed stresses and that nothing should interfere with using both sides of the belt in contact with the pulley wheels. This condition, while being essential for the test is not necessarily applicable to all installations, because for ordinary straight drives only one side of the belt is run in contact with the pulleys.

c The material of the belt is a very high-carbon steel carefully tempered and any joint which depends upon the use of solder must be made in such a way that the original temper is either not drawn or that it is drawn to only such a degree that the material is not damaged.

It can be readily seen that a joint could not be retempered without tempering the entire belt, because there would be a section each side of the heated part which would have received enough heat to draw its temper and still would not be hot enough to harden.

Efforts were made to develop a joint which satisfied the foregoing requirements, and after much experimentation it was found that the most successful manner of joining the belt ends, so far as the test was concerned, was to make a butted joint with the edges beveled about 60 deg. and then secured by means of silver solder. Care was taken to confine the annealing effect of the soldering flame to as small a length along the belt as possible and only enough solder was used to make the joint complete. With the ¾-in. belt it was possible to confine the annealing effect to a very small length (as little as ½ in.), and to so distribute the solder that it was not necessary to do any filing in order to make the joint ready for service.

Joints of this kind were used throughout the test with apparently no signs of weakening or failure and showing no undesirable effects on the running stability of the belt.

An attempt was made to weld the belting by means of an oxy-acetylene torch, but on account of the extreme thinness of the material and the high temperature required the effort was unsuccessful.

In an attempt to make a joint which would develop a large percentage of the original strength of the material, one of the ends to be joined was cut to a sharp V and the edges serrated, and the other end so cut as to interlock with it. It was expected that when this joint was silver-soldered the strain would be taken up by the material instead of by the solder as it would be with the simple butt-soldered joint. This method was not a success, because when heated to a sufficiently high temperature to flow the solder it buckled and twisted and could not be made flat.

Riveted joints were also tried and proved fairly satisfactory. The joints were made in the V-shape in order to distribute the rivets and both ends were cut out so that the tendency to stiffen the joint would be reduced to a minimum. They were made by the use of a punching die into which one end of the belt was clamped and fifteen No. 50 holes were punched. The other end was punched in the same die, being put through from the opposite end so that the holes in the two pieces exactly matched. The rivets used were No. 51 punchings from phosphor bronze about 0.03 in. thick. These were placed in the holes and headed down lightly on both sides, care being taken not to stretch the material by upsetting them too much. A joint of this type was run for a considerable length of time and then a very small crack was discovered in the edge. It is the opinion of the authors that with sufficient care and experimentation a very satisfactory riveted joint could be developed.

Why the Blueprint?

By H. W. Weisgerber

I was interested in an article by Frank Richards that was reprinted from the *American Machinist* in the *Compressed Air Magazine*. Upon looking at the title I thought here at least we are going to have something of real value; but not so, for the farther I read into the article, trouble was the only thing that I saw in his plan. I had visions of the photostat machine but no, he never mentioned it.

After finishing the article I came to the conclusion that the author knew nothing about the printing business and that his theory about reproduction on zinc plates was only a harmless "pipe dream."

I have been directly connected with blueprint departments for more than twenty years; and now in my present position in charge of the blueprint department of the Youngstown Sheet and Tube Co., where we run from one to four 100-yd. rolls of blueprint paper a day, I would consider an opportunity to save paper at the present prices to be most welcome. I fail, however, to see that opportunity in the use of zinc plates.

To use Mr. Richard's plan requires a printing press of some kind. The plates must either be nailed or screwed to wood blocks, put in a frame and fastened to the press. Then, if the lines and characters that form the drawing on the plate are all of a uniform height, all might be well; but would they be? If not, then they must be brought to the proper height by building up on the platen of the press with pieces of tissue paper so that the lines or characters will all print legibly. All of this requires time and patience, for if a letter or figure were missing the plate would be useless.

If only one or two copies of any particular drawing were desired, all of this preliminary work would be rather expensive. If a few hundred or a thousand copies were wanted it would be a mighty saving over the blueprint. Even if but one copy from the plate were wanted it would be necessary to put in the paper padding else the plate would make indentations in the paper that might blur certain characters in the second plate that would be placed in the press.

With some months experience in a small job printing office, coupled with fifteen years with a printing press that was used for title printing and other jobs in the blueprint department, I learned something about the accidents that will happen to type, plates and etchings. They must be handled with extreme care to prevent damage to their delicate surfaces and they must be scrubbed everytime they are used in order to keep the ink from clogging the small characters.

Mr. Richards refers to the drawings that he has incorporated in his article as being legible and easily read. But does he think that every Tom, Dick and Harry of a boy or man that he might place in a blueprint department could or would do as good work as a pressman employed on a magazine of the character of *American Machinist*? I think not. The magazine must use better ink than he would, and the type and cuts are in good condition; not having been battered about here and there in drawers and cabinets.

I will admit that smaller drawings than are now used would be more convenient to handle, but the process would lie in the direction of the use of the photostat; large drawings could be reduced to the size of sheets that these machines make, and then four or six of these sheets could be reduced again into one sheet which would bring the size of each drawing down to somewhere near the size that Mr. Richards advocates. With paper at the prevailing price, and likely to go higher, a way will soon be found to get along with far fewer prints—or else they will be made smaller by some process of photography. I have reproduced 33 x 42-in. drawings to lantern slide plates that were less than 3 x 3 in. and still had all lines and characters legible, but such fineness would scarcely do for printing-press work.

Inspection and the Modern Factory

By O. B. WHITTAKER

Inspection, as applied to modern factory practice, is the comparison of the factory's product in a semi-finished or finished state with that which the designer has portrayed by blueprint, sketch or other means.

THE subject of inspection usually interests the management in one of two ways depending upon the characteristics of the company in question. In a growing organization, if no inspection of the product has been inaugurated, the question confronting the management is when should inspection be started. If on the other hand inspection has been started, the extent to which it should be carried becomes a matter of prime importance.

In rendering decisions in either of these cases the investment must be considered a profitable one. No inspection department that is not a paying unit of the whole organization can be considered a success. The great variety of ways in which inspection brings about a saving requires the closest study of each individual case, as often the saving is made in such a way that it cannot be expressed in terms of money value. The cost of incorrect fulfillment of a contract on deliveries, or the indirect damage done by the delivery of a faulty product can never be fully determined. This point can be emphasized if the reader will imagine himself in the position of either the dealer or consumer, whichever the case may be, and choose from any of the various known materials on the market, some one manufacturer's product in which a feeling of great faith is held. An analysis of the reason for the confidence placed in the one chosen will, it is almost certain, be found to lie in the dependability of that company to supply the material as ordered and as represented in any preliminary negotiation. The large mail order houses in this country owe practically their entire success to the confidence which their customers have found they can place in them to supply the material as represented.

Practically all large companies that had their origin in the so called "One man shop" have had to face the necessity of instituting inspection at one time or another. The topic at this juncture is attacked from many angles, but despite this, there is a more or less definite means of determining the proper time to inaugurate inspection if the general characteristics of the company are known.

In the small factory or shop each workman can be depended upon to exercise more care in his work since he takes greater pride in making and fitting each individual part. He has a hand in the final assembly of the product and then, too, any mistakes made can be easily traced to the one responsible for them. Also in the small organizations, the foreman can more effectively supervise the work of the individual workman, especially in instances where the foreman is responsible for all operations necessary in making a given product from the beginning to the end.

As long as this condition remains, there is little or no use for an inspection department, but when it becomes necessary to expand the organization so that the shop becomes specialized, that is when certain parts of the factory are set aside for carrying on certain operations only, it immediately becomes necessary to introduce inspection, to prevent one specialized department from passing inferior or spoiled work to the next department; to prevent disputes between foremen over inferior or spoiled material; to create fair and clean competition between departments; to assist the management in localizing any trouble which may be found to exist in the product and if in a factory where "piece work" is done, to pass on the quality and quantity of the men's output. Inspection thus becomes the element which overcomes the detrimental factors of the specialized factory and, as specialization is the key to the successful operation of the large factory, inspection may be rightfully claimed as the keystone.

Inspection and The Product

All the details of an inspection organization should be adapted to the product to be inspected. Very frequently no precedent can be found covering the inspection of certain products or parts of products. This condition may well emphasize the need of a man rich in the possession of original ideas and filled with initiative, to fill the position of chief inspector.

Before any inspection is started, a very careful study of the product should be made with a view to determine in what quantities the product will be made; the extent of identical part production and the accuracy to be obtained.

Inspection of parts manufactured in large quantities is a comparatively easy matter as in such cases it is profitable to make gages of the "go and not go" type and other special tools. Such special tools, with very little patience exercised in training the personnel, permit the employment of comparatively unskilled labor, thus appreciably reducing the cost of inspection.

The manufacturing of parts in small quantities presents large and more difficult problems, as in many cases it not only becomes problematical whether or not special gages and fixtures are necessary, but those responsible are confronted with the difficulty of obtaining and training satisfactory help where "fixed" gages are not profitable.

On the other hand it will be found advisable in many instances to make special inspection fixtures even though the part to be inspected is not made in quantities which would ordinarily warrant "fixed" gages, especially if accuracy or a high degree of interchangeability is required.

Some companies have gone so far as to provide a separate organization, under the direction of the inspection department whose duty it is to plan and prepare the best and most economical way of inspecting parts. This organization may, in co-operation with the tool designer, design any special inspection tools found necessary. As a study is made of each part, a set of instructions for inspecting it is prepared. This serves as a guide for the inspector who will later inspect the part.

There is a broad variety of ideas as to the relation

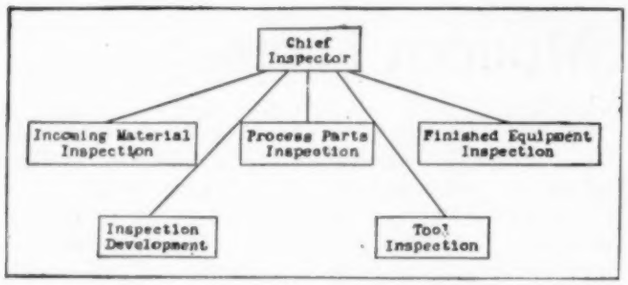


FIG. 1. ORGANIZATION CHART OF INSPECTION DEPARTMENT

of the inspection department with the other departments of an organization. Many are exponents of the idea of having it as a part of the engineering organization; others advocate that it should come under the factory's control and still others advocate that it should be an independent part of the organization with its line of responsibility meeting the others at the general manager of the entire organization.

Many good and bad points can be advanced for all of these plans, but the second, that of bringing the inspection department under the factory manager, seems to work out best. This is especially true if there is a factory manager superior to the factory superintendent, methods superintendent, production superintendent, etc., thus giving the head of the inspection department an equal footing with the heads of other departments in the factory division. In some factories the head of the inspection department is responsible to the factory superintendent. It is generally believed, however, that this is not good practice as it vests almost unlimited control of the product in the factory superintendent's hands. There are, of course, exceptions to this, but where such an arrangement is to be found working satisfactorily, a man of unusual breadth and ability will be found filling the position of factory superintendent.

In general, it is best to place the head of the inspection department on equal footing with the factory superintendent. Any differences coming up between them will have to be settled by the factory manager or management.

The superintendent of production is very apt to be one of the inspector's most disturbing factors since it is his task to meet a certain promised delivery, he is very apt to influence the inspector against his own best judgment regarding defective parts or material.

Some factory managers favor engineering control over the inspectors, as it is the belief in this case that the engineer is the most capable of finally judging the product of his own design. This relation of the inspector to the rest of the factory organization has its advantages in keeping final decisions entirely away from all branches of the factory, but tends greatly to isolate the inspection staff from the factory organization and its routine. In many factories the inspector is so nearly an integral part of the factory organization that any tendency to make him too independent causes a break in the routine which has been found to be most efficient.

Necessity For Full Co-operation

Regardless of his line of responsibility, the inspector must be willing to co-operate fully with whatever branch of the whole organization he may be called upon to serve. Any lack of co-operation and willingness to assist on the part of the inspector makes him a dangerous link in the chain of a factory's organization and in such cases he should be removed, even though it results in sacrificing inspection of a part, as in such cases he readily becomes a worse menace than the entire omission of the inspection department.

In any case the inspector must either be or become, as soon as possible, an authority on the manufacturing operations he has to inspect and then be ready to render any assistance that may be required by the man carrying out those operations. In many cases witnessed by the writer, the inspector simply attached rejection tags to the rejected articles and returned them to the production department with no reason given for their return. It was then necessary for the foreman of the production department concerned to go to the inspector and inquire the reasons the articles were rejected,—resulting in the loss of time amounting to more perhaps than the value of the parts. A better method would appear to lie in encouraging or perhaps compelling the inspector to analyze the cause of the part being spoiled and communicate the findings to the foreman at once and have the part returned as soon as possible with all details written out clearly on the rejecting tag.

A very good example of such co-operation was recently witnessed where a company was manufacturing large numbers of delicate instruments for the Government. There had been many rejections due to difficulty in getting certain of the parts to align themselves with each other properly. The almost continuous rejection of the parts by the assistant inspector gave the inspector in charge of that branch of the organization abundant time to study the problem. This man worked nights, Saturday afternoons, Sundays and holidays for several weeks and finally offered his suggestion as to how the trouble could be overcome. His suggestion was adopted and proved to be the right solution to the problem. This accomplishment was particularly meritorious since the trouble had been continuously before the engineers for solution since it first arose. It is not always that an inspector has this same opportunity, but again, how many inspectors are confronted with similar opportunities and fail to sense them at all,—in fact the inspector's intimacy with the product should put him in an excellent position to improve the quality materially.

Convincing the foremen that the inspector is willing to co-operate with them in bettering the product is of first importance in a factory where harmony is to exist between the production and inspection departments. An instance is recalled where in starting an inspection department in a factory the foremen demanded that they be informed of the policies of the new organiza-

RECEIVING RECORD — No. 35020

Received from: J.J.Chalous, Watervliet, N.Y. — Req. No.: 1234 Riley — Purchase Order No.: 101010

Via: Parcel Post — Charges: — Specification No.: 9876 — Part No.: 30796-98

Quantity	Description	Weight	Unit Pr.	Value
200	1 Minute Level Vials			
100	5 " " "			

Date: 3-16-1920 — Receiving Clerk: Meyerrose. — Entered:

INSPECTION RECORD

Quantity Accepted	Quantity Rejected	Inspected By	Date	Order to be Replaced
195/ 97	5-3	Gough	3-16-1920	

Remarks: 6 Rejections broken in transit.
2 Rejections Broken for Inspection purposes.
O.K. (W.G.)

Quan. Rec'd	Received By	Date	Floor	Section	Bin	Entered	Noted
195-97	CROOKE	3-16-1920	2	A	3	3-16-1920	

FIG. 2. RECORD OF MATERIAL RECEIVED

tion. They objected to certain records that were being kept which gave a summary of all material that passed through the inspector's hands during the day, the number of rejections and the department concerned. In some way the foremen obtained the idea that these records were being kept to incriminate them. As a matter of fact, the real purpose of these records was to find in what factory department the inspectors were co-operating properly with the factory, a continual high rejection usually indicating the lack of proper co-ordination between the two departments. A meeting of the factory foremen and all inspectors was called by the management and the matter thoroughly discussed and the results were almost miraculous in reducing the number of rejections and improving the product.

In factories where piece work is done, the co-operation between the factory and inspection department employees must be carefully controlled, as unfair decisions may result since the rejection of a part means a loss to the man making it. In such factories inspection is usually of a highly routine nature and but few outside of the foremen inspectors are able to co-operate with the factory efficiently. This to some extent overcomes automatically the dangers of too close association between the inspectors and the factory employees.

The routing of the product also bears closely upon this general topic. In all well organized factories the product passes through inspector's hands after each important operation and finally into stock. In case of rejection it is in most organizations returned to the production department which performed the operation for which the part was rejected. If the fault cannot be easily corrected, two courses are open, and the next move will depend entirely upon the rest of the factory organization. In instances where there is a salvage

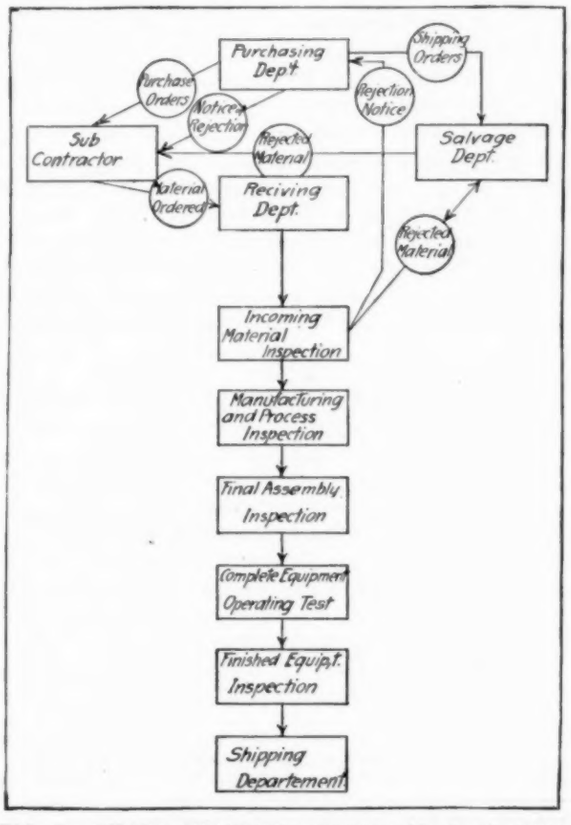


FIG. 3. CHART SHOWING METHOD OF HANDLING PURCHASED MATERIAL

SYMBOL	NAME OF PART				PART No.	DATE	SHEET No.
G4	BINNACLE BASE MK.IV COMPASS				57319	9-26-19	1
ISSUED BY	MATERIAL			MFG. QUAN.	SUPERSEDED BY	APPROVED	NO. OF SHEETS
WFM	CAST IRON						

	OPERATION	FIXTURE	LOCATION	TOOLS	DEPT No.	MACH. OR BENCH No.	TIME HOURS SET UP	TIME HOURS PER PC.	TIME HOURS ALLOW
	Purchased Casting			Pattern 22954-E					
1	Inspect				IH				
2	Rough Grind O.D.	F X T-6738-FG	8K		8F				
3	Inspect				"				
4	Chuck on inside of base, Face back, Cut off front end to length. Bore front end to 9.500"		9E	Spider Center T-3558-FG	9B	E L			
5	Drill 4 holes in base	D J *T-7261-FG	"	3/4" Drill	8G	1 DP Barnes 84			
6	Drill 1 hole in side of Base	D J *T-7261-FG	8K	1 23/32" Drill	8G	1 DP Barnes 84			
7	Tap 1 hole		"	1 1/2" Pipe Tap	"	"			
8	C'bore 4 holes in Base		"	CB *SG1169-70	"	"			
9	Drill 8 holes	D J *T-2988-FG	"	5/16" 1/4" Drills	8G	Prentiss 80 DP			
10	Countersink 8 holes		"	C'sink	"	1 P			
11	Inspect				"				
12	Finish as specified				8F				
13	Inspect								

FIG. 4. OPERATION SHEET INDICATING PERIODS OF INSPECTION

department the rejected part may be forwarded there and an effort may be made to salvage it, or the manufacturing department may scrap it and charge it off the books. It is obvious that in case the part is forwarded to the salvage department, and there found to be beyond reclaiming, that it should be charged off the books in order to keep the stock records accurate and up to date. Precaution should be taken to see that no parts enter the stock rooms except through recognized channels, in order to prevent rejected material from gaining access to a place where it will enter into the regular product as first class material.

TOLERANCES

Properly prepared blueprints are as essential to the inspector as are his tools. Few blueprints carry all the necessary information that may be of assistance to the men using them. It is not infrequent that it is impossible to carry out exactly the wishes of the designer as specified on the print and in anticipation of this, a working allowance for each dimension is usually given on all manufacturing prints. This allowance is usually known as a working tolerance. For example—a certain dimension may call for one inch. It is a well-known fact that except by accident, a piece of material cannot be cut to exactly one inch, it might be only 0.0001 over and yet that may or may not be close enough for the requirements. If the piece could be 0.0001 in. under or over size, it would be said to have a tolerance of 0.0001 in., or in other words, the piece could be used whether it was 0.9999 in. or not more than 1.0001 inch.

The use of the tolerance system has two very distinct advantages; it increases efficiency by indicating to the mechanic the relative importance of any given dimension and it removes the use of personal judgment on the part of the mechanic and inspector.

The subject of tools for the inspector is a matter of ranking importance. The tools for the inspection department should be chosen with the utmost regard for the nature of the product to be inspected.

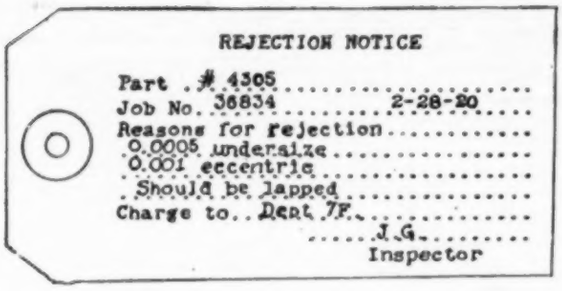


FIG. 5. REJECTION TAG

Where a product manufactured in quantities is to be inspected, it is usually best to consider special tools and gages especially made or set for the product. This is often found advisable where quantity is less evident but where close tolerances are necessary. For instances not included in the above, the ordinary mechanic's measuring tools will usually be found to be satisfactory.

Every factory should be equipped with a set of accurate gage blocks with which all of the tools or equipment used to gage the product should be frequently checked. Such blocks, when properly used, make possible the interchangeability of parts—they serve as a standard to which parts may be made in opposite parts of the country and still fit when assembled, etc. In this age of highly specialized manufacture, these are important matters. Take as an example the manufacture of the Liberty Motor; dozens of highly specialized plants in widely separated parts of the country contributed parts to that motor and they fit accurately when assembled. Of course, all the credit for this cannot be taken by the gage blocks, but we can rest assured that they made a great contribution to it.

Such a set of standards in the average machine shop will be found in the hands of the tool inspector where it is used for checking all manufacturing and inspecting tools. Some factories find it advisable to carry matters in this respect a step further by making a set of master gages from recognized standards and then using the master gages for checking the working gages and then checking back with the recognized standards at only infrequent intervals. This method further prevents wear in the standards, and is broadly practiced where possibly some of the most exacting problems of interchangeability are encountered, such as in the manufacture of ball bearings.

In factories where electrical machinery is manufactured, equal care should be taken to see that the standard instruments are kept uniformly accurate.

Organization

The plan of organization for the inspection department itself depends upon the size of the plant and the nature of its products.

Most plants of a sufficient size putting out a product of a mechanical nature have an organization laid out along the lines represented by the chart shown in Fig. 1.

The responsibilities of the department units may be outlined as follows:

The Chief Inspector is responsible to his superior for the direction, supervision, and co-ordination of all sections of the inspection department.

The *Incoming Material Inspector* is responsible for:

(a) Keeping on file copies of all purchase drawings and specifications under which materials are purchased. These to be kept in a convenient manner for ready reference when shipments on purchase orders are received.
(b) Checking all incoming material against the requirements specified on the purchase orders, and marking the date and quantity accepted and rejected on the receiving record.
(c) Forwarding all rejected incoming material with proper information to the salvage department.
(d) Rendering proper reports as requested by the chief inspector.

The Process Parts Inspection Section is responsible for:

(a) Inspection of all process parts between important operations in their manufacture.
(b) Inspection of all finished patterns before they go to the foundry.
(c) Inspection of all castings as they come from the foundry.
(d) Notifying the production department of any delays in the transfer of material to or from any of the inspection benches.
(e) Co-ordinating the work of the inspectors with the factory foremen.
(f) Rendering proper reports as requested by the chief inspector.

The Finished Equipment Inspection Section is responsible for:

(a) Inspecting all finished material and equipment and checking its mechanical and electrical features against the requirements of the order and specifications covering the material before being turned over to the shipping department.
(b) Obtaining the certificate of approval or acceptance from the customers when required.
(c) Rendering proper reports as requested by the chief inspector.

The Tool Inspection Section is responsible for:

(a) Checking all tools, gages, fixtures, etc., with requirements of specifications and drawings immediately after they are completed by the tool makers and before they are turned over to the production department.
(b) Checking any gages and fixtures that may be returned by the shop or other sections of the inspection department for rechecking.
(c) Rendering proper reports as requested by the chief inspector.

The Inspection Development Section is responsible for:

(a) Developing ways and means of checking all parts to see that they conform to the terms of the requirements.
(b) Rendering proper reports as required by the chief inspector.

Incoming Material Inspection Section

Almost every factory purchases raw material. If the factory is of any consequence at all the purchasing agent hasn't time to inspect the material he buys, nor is it usually the case that he is capable of telling whether the material he has purchased is satisfactory or not, even though he had the time. His profession is a buyer and not an engineer or inspector. It is therefore somebody's business to see that the material purchased is what was ordered.

The incoming material inspector must know the requirements of the material he is to inspect and he should know it in time to make any special arrangements or provide any special equipment necessary. He is therefore supplied with a copy of the purchase order and complete specifications covering the material to be purchased. The purchase order indicates whether inspection is to be made at the plant of the contractor or at the home plant; delivery dates, etc. Payment on purchased material is not made until the material is approved by the inspectors, a space being provided on the receiving record, Fig. 2, for the inspector's approval or disapproval. Fig. 3 illustrates in detail the method used in handling purchased material.

Process Parts Inspection Section

After the material has been approved and placed in stock, all subsequent inspection, up to the point of testing, is made by the process parts inspection section. This group of inspectors approve the material between all important operations as specified by the factory on the operation cards, Fig. 4, which indicate at what periods the part shall be inspected. All material must be approved before being sent to the stock room. This

INSPECTION INSTRUCTIONS

Name of Part	Operation	Prepared By	Approved By	Date
Guide bearing case	Grinding	J.F.C.	L.M.F.	1-8-20

Tools	Plug gage T-3689
Location	30 crib bin No. 84
Procedure	The tool for this part is a "go and no go" plug gage and is to be used with no variations from the tolerances allowed on it.

FIG. 6. REPORT OF INSPECTION DEVELOPMENT SECTION

section also takes care of all testing done on unit and sub-assembly parts. Upon completion of the product and after a thorough assembly inspection by the process part inspectors, the product is turned over to the test department, which is a separate part of the company's organization. It is here given a thorough test and if approved, is turned over to the finished equipment inspection section.

Finished Equipment Inspection

The finished-equipment inspectors check the material thoroughly against the customer's specifications to see that it complies with them in every respect.

Rejected Material

All rejected material is returned to the department responsible for the fault for which it was rejected. A rejection tag, Fig. 5, describing in detail the reasons for the rejection is attached to the material before its return. This tag is signed by the foreman inspector.

The department responsible for the trouble investigates the reasons for the material's rejection, with a view to reclaiming it. If it can be corrected, it is fixed up and returned to the inspectors for approval. If it cannot be reclaimed, it is forwarded to the salvage department. If it is an assembled unit, the good parts are removed and returned to stock and the bad parts scrapped.

Inspection Development Section

This section is continually in touch with new work that is being prepared to be placed in the shop. Its work bears the same relation to the inspection department as the methods department does to the factory; in other words, it makes a thorough study of the product and prepares ways and means of inspecting it. Careful reports, Fig. 6, are made as a result of the study of each part. These records then serve as a guide to the inspector, who will have to inspect the part when it gets into production.

Drilling and Tapping Ring Gears

By Frank C. Hudson

Among the specialties of the Weeks-Hoffman Co., Syracuse, N. Y., is the manufacture of the ring gears for cars of various kinds. These are machined in the regular way, but some special tooling is necessary when it comes to drilling and tapping.

A multiple-spindle drilling machine has been rigged up, as shown in Fig. 1, so as to drill all the holes in two of the gear blanks at one setting. The guide plate is fastened to the column of the drilling machine, so as to guide the drills and insure the gears being interchangeable.

The gears to be drilled are mounted in pairs on the drilling table, the table being suitably indexed in its proper position, so that the guide plates will center the drills correctly. It will be noted that the guide plate *A* has a raised place in the center of each ring of drills, which performs the double function of allowing space for the hub of the gear and also of distributing lubricant to the drills.

The size of the pipes for distributing soda or other cutting compound indicates that flooded lubrication is believed in.

Tapping the drilled holes is also done in a multiple-spindle drilling machine, which is, however, set up for

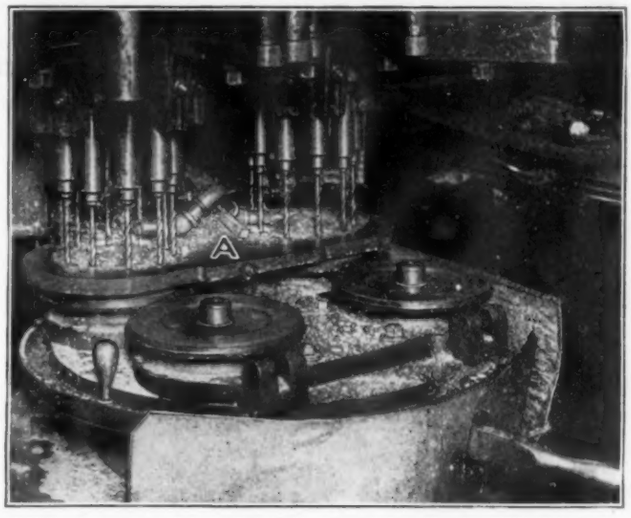


FIG. 1. DRILLING TWO GEARS AT ONCE

only one ring gear, involving the use of ten taps as shown in Fig. 2. There is nothing unusual about this set-up, except perhaps the simplicity of the holding fixture, which only has to support the gear and to resist an upward pull. The ten taps have no tendency to turn the gear as a whole.

Features of Operation

It will be noted that there is plenty of play, both vertically and in twisting around the spindle, in the driving connection at *A*. The tapering chuck carries a sleeve which is well supported by the spindle inside, but allows it sufficient motion to prevent any tendency to bind and to allow slack when the spindle reverses from one direction to the other. An ample supply of cutting lubricant is provided by the large pipe which encircles the taps, the holes in the pipe being so located as to thoroughly lubricate each individual tap as it revolves.

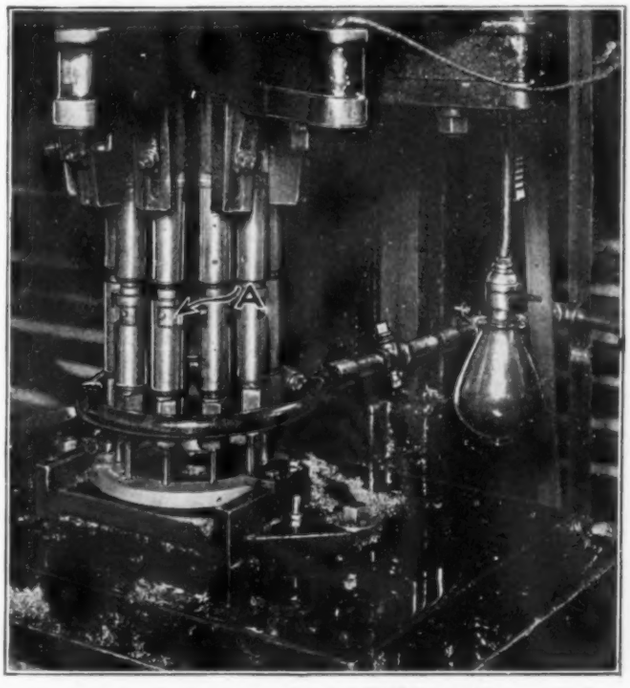


FIG. 2. TAPPING WITH TEN SPINDLES

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas

The Evolution of the Workshop—XII

By H. H. MANCHESTER

The development which took place in the metal-working industries of Great Britain during the period between 1820 and 1870 was very great, and it shows to what an extent the factory system had grown. Improvements made in the method of working hot metal were as important as those arising in machine-tool work, the rapidity of the development being truly striking. The more general application of steam power and the raising of the standard of accuracy in machine work are among the important points discussed by the author.

(Part XI appeared in our July 29 issue.)

IN GREAT BRITAIN the decade following 1820 was very largely one of improvement on the machine tools such as the lathe and planer which had recently been invented, and it was not until two decades later that any new tools of prime importance were developed. Several of the notable improvements of the period were credited to Joseph Clement, who, it will be remembered, was one of the first to adopt the planing machine to iron. Between 1820 and 1825 Clement built planing machines for iron which were used in his shop, and the combined these in various ways with the lathe. While the work of this machine was far more accurate than could have been attained by other methods, it was not at all cheap, for Clement's price was 1½ cents a square inch, at a time when skilled labor received only about fifty cents a day.

There is a long description of Clement's planer in the "Transactions of the Society of Arts" in 1832. This account contains the following passage, "This planing machine for metals . . . performs its work in right lines, and is so constructed that during longitudinal cuts the tool is stationary and the work moves, but during lateral cuts the tool moves. The tools or cutters are similar to those used on the lathe, their forms being in like manner varied from a strong point to a chisel-shaped edge to finish the work. In the lathe a mandril supported by immovable columns presents the work to the tool in the firmest manner and with the least possible friction. . . . Mr. Clement also saves time, or uses the whole time, by making cuts both ways, there being two cutters mounted, one to cut while going, the other while returning."

In 1827 Clement invented a self-regulating lathe, so that practically the same quantity of metal could always

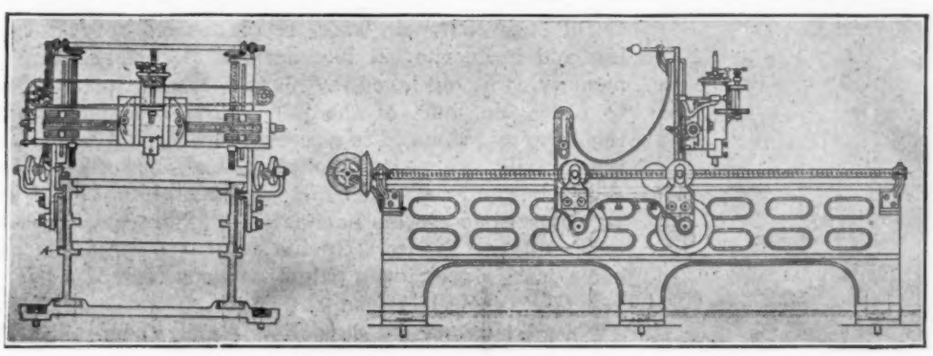


FIG. 74. WHITWORTH'S PLANE FOR IRON, ENGLAND, 1835

FIG. 75. ROLLING BAR IRON IN THE FIFTIES

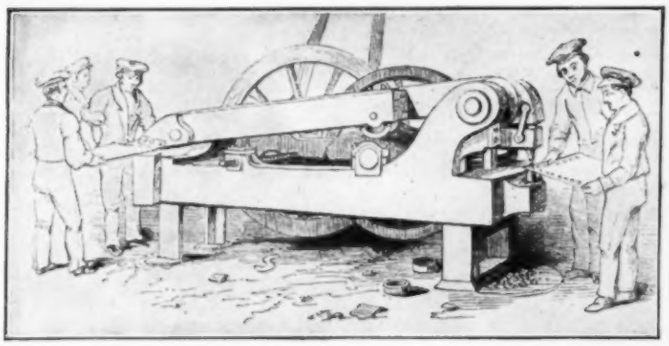


FIG. 76. CUTTING AND PUNCHING SHEET IRON, 1850

FIG. 77. A BORING MACHINE OF 1850

be cut in the same length of time. For this he was given a gold medal by the Society of Arts. The next year the same society gave him a silver medal for his self-adjusting double-driving center chuck. About this time he began to standardize the number of threads according to length and pitch in the screws he made, and constructed a machine which would produce them in accordance with this standard. In the same year he began to produce fluted taps with a revolving cutter, and also invented a headless tap.

As is regularly the case, the patents of the period evinced the demands rather than the actual accomplishments.

A so-called universal chuck was invented by Bell in 1821, and a gun-stock lathe, probably suggested by Blanchard's, in 1822. In 1825 Cornelius Whitehouse received letters patent for a method of welding pipe. That the lathe was far from being generally run by steam power is shown by a patent for the application of steam power to it given to L. R. Fitzmaurice in 1828. Tyndall received a patent for nail rolling in 1827, and there were various patents for nail cutting in 1830 and 1831. At about this time we hear also of drawn wire nails in Paris, which seems to be their first introduction.

Inventions in the Thirties

Several important inventions in machine tools date from the thirties. Steel screw manufacture was begun by James Perry in 1830. Whitworth's highly successful plane, shown in Fig. 74, was patented in 1835. New boring machines also were invented by Whitworth, and a new punching machine by Charles Phillips. Presses and stamps were improved upon by Sharp, Whitworth, and Bodmer. In 1836 James Nasmyth invented a shaping machine which was long known as "Nasmyth's steel arm." Improvements in screw- and bolt-cutting machines belong also to this period. Between 1834 and 1841 Whitworth probably did more than anyone had previously done toward standardizing the threads in screws, bolts, and nuts, establishing a constant angle for the threads of 55 deg.

Iron canal boats had been built as early as 1786, but the first iron steamer seems to have been constructed in 1821. It was intended merely for river purposes, and the first iron steam ships to cross the Atlantic were the Sirius and Great Western in 1838.

The increasing importance of iron ships, the steam engine, and the demands of the new locomotive are suggested by the invention of a riveting machine worked by steam by William Fairbain in 1839. This was applied both to boilers and ships, and may be said to have made practicable the building of armored ships which followed a decade or so later. Patents for rolling rails were taken out by Joseph Freeman in 1837, and by James Hardy and J. G. Bodmer in 1838.

Attention was at this period being called to gearing and the form of the teeth for wheels. These were still constructed almost entirely in accordance with the individual whim of each machinist without any definite scientific principles to follow. In 1837 J. I. Hawkins made some valuable suggestions on the use of the involute curve for the outlines of teeth. Four years later the subject was taken up more in detail by Professor Wills, who established at least a few mathematical laws in regard to the subject.

During the construction of a new machine shop J. G. Bodmer in 1839 and 1841 took out patents covering various machines and their arrangement in the new shop. These patents covered in all about forty improvements, and, together with the careful planning of the entire shop, made an important step in the evolution of shop practice. Bodmer, by the way, was the inventor of a vertical boring mill which he designated and intended, however, as a circular planer.

The steam hammer, which revolutionized heavy forging and made the tilt hammer scarcely more than a memory, was designed by James Nasmyth in 1838 to forge the shaft of the "Great Britain," but when the drive was changed to a screw propeller, the idea was temporarily dropped. The plans had, however, been shown to two Frenchmen, and four years later Nasmyth was amazed to see his hammer at work in the Creusot iron mills in France. On his return to England the same year he took out a patent, and constructed a hammer that weighed 1½ tons.

Nasmyth's original invention simply admitted the steam beneath the piston in such a way that it raised this and thereby the hammer. In 1843, however, an automatic movement for the hammer was designed by

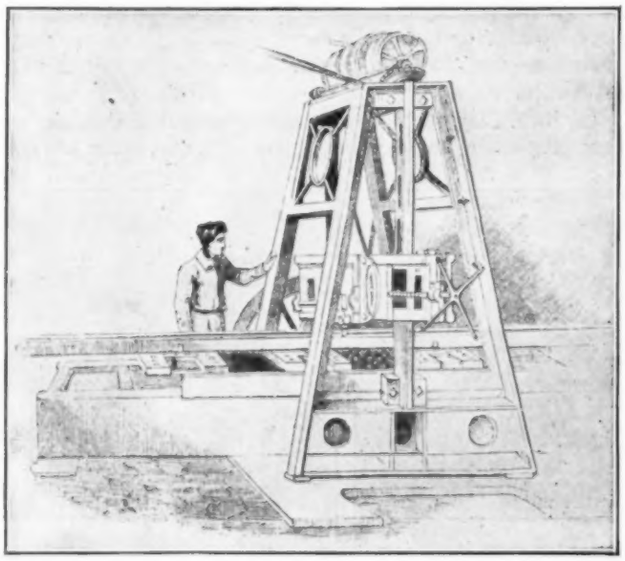


FIG. 78. A PLANING MACHINE OF 1853

FIG. 79. A WOMAN CUTTING SCREW THREADS, ABOUT 1853

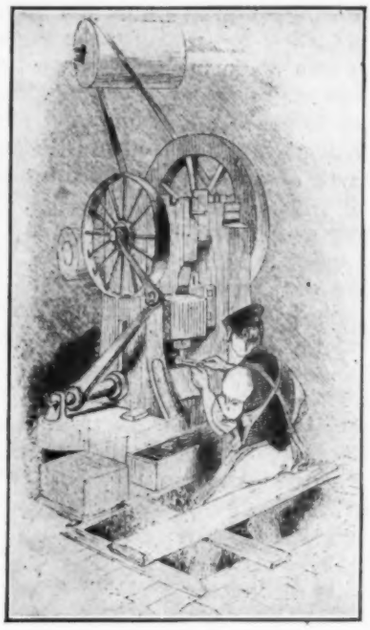


FIG. 80. MAKING THE HEADS OF SCREWS, ABOUT 1853

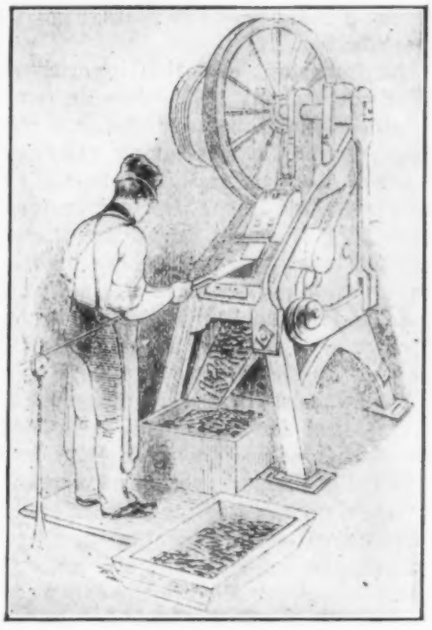


FIG. 81. MAKING CUT NAILS, MIDDLE OF THE 19TH CENTURY

Wilson, and it was not long before the hammer could be raised, forced down, and stopped at any point desired.

Crude milling machines were used by Nasmyth, Sharp, and Haley in the early thirties, but they could not have been very successful, because two decades later the milling machines imported from America were considered far more efficient than anything of the sort known in England.

In spite of the many planing machines for iron which had been already constructed, Whitworth in a paper read at the British Association at Glasgow, declared: "A true surface instead of being as it ought to be in common use, is almost unknown; few mechanics have any distinct knowledge of the method to be pursued for obtaining it, nor do any practical men sufficiently advert either to the immense importance, or to the comparative facility of the acquisition." Whitworth's method was to obtain his plane surface by scraping, rather than grinding, as he claimed the latter method could never give satisfactory results.

In the forties we read of various new machines, most of which were, however, improvements rather than basic patents. In 1840 a patent for a shaping machine was taken out by Whitworth and John Spear, and the next year another for a shaper by Henry Davies. This is about the same date as the invention of the shaper for iron in America, but it seems to have come into more general use in the latter country.

An indication of an interesting advance is the patent of H. R. Palmer in 1842 for making corrugated iron for roofs. A patent for rolling iron for suspension bridges was given to Thomas Howard in 1845, although such bridges themselves had been introduced in the previous century. Fig. 75 shows how bar iron was rolled after the introduction of this method.

In 1842 Nasmyth applied his steam hammer to an improved form of stamping machine, and another machine for stamping and shaping was patented by T. F. Griffiths in 1846. In the latter year improved machines for shearing plates were patented by Charles May and Charles Fox. A patent for pressing by steam power was given to Richard Prosser in 1850. Various other patents were taken out for shearing, shaping, and com-

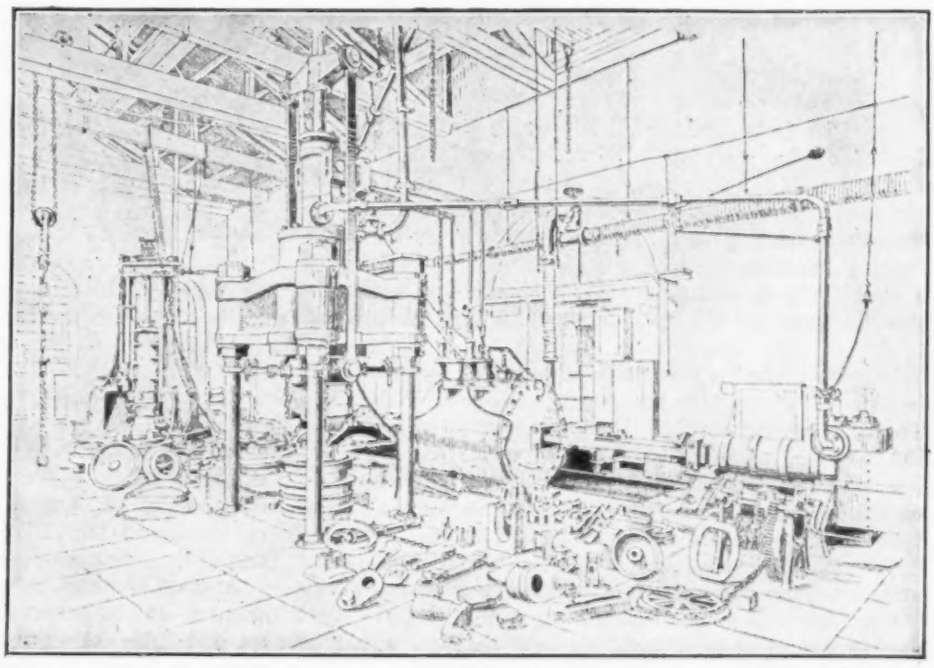


FIG. 82. HASWELL'S HYDRAULIC PRESS, ENGLAND, 1863

pressing in the next few years, Fig. 76 showing a typical machine.

An important evolution in measuring was made by Whitworth about 1856, when he combined his recently attained true planes and standard screws to produce a gage capable of measuring one-twenty-thousandth of an inch about as easily as one sixty-fourth of an inch was estimated in the previous century.

In 1859 Nasmyth introduced traversing or slot-drilling machines in which the motion was applied to either the work or the drill. In this period there were various patents for machines for slot drilling, milling, tapping, shaping, and planing, all before 1860, but they were in reality merely improvements. Figs. 77 and 78 show machine tools which were typical of the fifties. Fig. 79 shows that female labor was applied at that time to some machine work, while Figs. 80 and 81 give examples of some of the best specialized machinery of the times.

One important principle established by Whitworth was the use of hollow castings for machine tools in order to combine lightness and strength. In 1859 this principle was also applied to the construction of girders and beams. In 1855 J. Herdman received a patent for a cellular formation in such structural iron.

A great advance in ship building which served to increase incalculably the importance of iron and steel work was that of armored ships. As early as 1854 a floating battery had been protected with iron plates, but the first armored ship seems to have been the "La Gloire" of France, which appeared in 1858. The first English ship with armor was the "Warrior" built in 1859. That very year John Arrowsmith took out a patent for rolling iron plates for ships, and the next year Lancaster and others patented steel plates for ships. In 1861 another patent was granted for the use of Bessemer steel for this purpose. These ships were as yet experiments when the success of the "Virginia" or "Merrimac" over the wooden ships in Hampton Roads, and the victory of the "Monitor" revolutionized all ship building.

The first extensive examples of wire rope transmission seem to date from 1859. This was of importance in doing the heavier work required at the larger plants which were then being established.

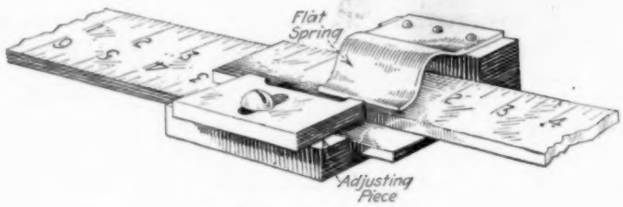
Another important improvement was the hydraulic press or hammer, shown in Fig. 82, which was built by Haswell in 1860, and which did much to increase the facility of fast forging. In 1865 Nasmyth & Co. constructed a 72-ton hammer. The next year the self-acting steam hammer was invented by Charles Emmet, and the atmospheric hammer by D. Grinshaw, as well as a forging machine for iron wheels by Holliday. In 1867 a double-acting steam hammer of somewhat new construction was put out by Thwaites and Carbutt of Bradford.

In some ways the best conception of the machine shop in England about fifty years ago is given by P. R. Cola. The development reached there is summarized by him in the following passage: "Lathes are now made in . . . Europe that would turn with ease a mass of fifty tons in weight, or as many feet in length; planing machines that will bring to truth and flatness, surfaces of 40 feet by 10 or 12 feet; boring machines that will scoop out cylinders more than 12 feet in diameter; slotting machines that will gradually chop asunder a block of steel a yard thick; shears that will bite through a bar of forged iron a foot wide; and steam hammers of twenty tons and upwards, falling twelve feet, whose blow at a distance is felt as that of an earthquake." Cola also gives an estimate of the machine tools required for a workshop fitted to do all kinds of repairing for steamships and manufacturing plants. This estimate is of interest in enumerating not only the machines but the prices prevalent at that time.

Attachment for Extending a Scale

By R. H. Kasper

A scale may easily be extended by the use of the attachment shown in the sketch, which firmly clamps two scales together and still leaves them free to slide. The scales are held together by the friction induced by



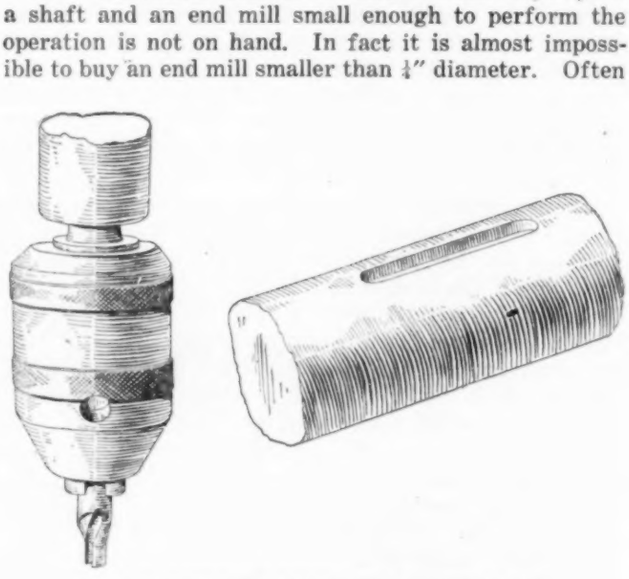
CONNECTOR FOR SCALES

the spring. Adjustment is provided for using scales of different widths. Two scales, held by this attachment, may be inserted into inconvenient places and extended. After the measurement has been taken, the length is reduced and the scales withdrawn.

Cutting Keyways with a Center Drill

By H. W. Armstrong

It is sometimes desired to mill a small keyway in a shaft and an end mill small enough to perform the operation is not on hand. In fact it is almost impossible to buy an end mill smaller than ¼" diameter. Often



CENTER DRILL GROUND FOR END MILLING

a keyway is made by drilling a hole and shaping into it or by using a Woodruff key cutter which may be obtained in small sizes. However the disadvantage to this method is that the end of the keyway takes a radius from the cutter which is not always desired.

A good method is to take a combination drill and counter-sink or center drill, grind flat on end and use as an end mill. An ordinary drill of the required diameter may also be used.

Power Consumed in Milling

By FRED A. PARSONS
Chief Engineer, Kempsmith Manufacturing Co., Milwaukee, Wis.

This investigation of the variables affecting the power consumed in milling, was undertaken for the purpose of constructing a slide rule which would indicate, for various cuts, the power required, and therefore, the machine best adapted for the job.

THE data available were a large number of tests made by the Kempsmith Manufacturing Co. on various Kempsmith millers, especially the No. 4 Maximiller and the No. 33 Production miller. Because these tests were not made for this purpose the majority are not well adapted, too many factors being varied at once and too much time having elapsed between suitable comparisons to permit exact knowledge of all conditions such as sharpness of cutter, motor efficiency, accuracy of electrical instruments, etc. For this reason they must be considered only as preliminary figures of reasonable accuracy.

It appears that the factors which affect the power consumed and their effect, if other things are equal (some of the items being different for spiral and face mills), is as follows:

Feed in Inches Per Minute. Affects power directly according to f;

$$\frac{f}{F} = \frac{p}{P}$$

Feed in Inches per Tooth of Cutter. Affects power inversely according to $f^{0.5}$ for spiral mills, or $f^{0.4}$ for face mills

$$\textit{For Spiral Mills } \frac{f^{0.5}}{F^{0.5}} = \frac{P}{p}$$

$$\textit{For Face Mills } \frac{f^{0.4}}{F^{0.4}} = \frac{P}{p}$$

Note—In computing power, both feed in inches per minute and feed per tooth must be considered.

Width of Cut. Affects power directly according to W.

$$\frac{w}{W} = \frac{p}{P}$$

Depth of Cut. For spiral mills affects power in two ways, the combined effect being directly according to $d^{0.78}$;

$$\frac{d^{0.78}}{D^{0.78}} = \frac{P}{p}$$

For face mills affects power directly according to d;

$$\frac{d}{D} = \frac{p}{P}$$

Material Cut. Power required is in about the following ratio:

Cast iron, 1; cast steel, 1.65; and bar steel, 1.65.

Type of Machine Used. Affects power required in about the following ratio:

Maximillers, 1; cone type, 1; No. 33 Production, 1.15.

Spindle Speed Used. Affects power required in about the following ratio (this varies somewhat on different types of machines and ranges of speed).

Lowest speed, 1; highest speed, 1.10.

Number of Teeth in Cutter. Has very pronounced effect, included in the expression of "feed in inches per tooth of cutter" (see above). If considered alone affects power inversely as $t^{0.5}$ for spiral mills and as $t^{0.4}$ for face mills.

$$\textit{For spiral mills } \frac{t^{0.5}}{T^{0.5}} = \frac{P}{p}$$

$$\textit{For face mills } \frac{t^{0.4}}{T^{0.4}} = \frac{P}{p}$$

An inserted blade spiral mill, having the effect of a single tooth, broken up and staggered around the body to reduce shock (first design stellite maxi-cutter spiral mill) gives 4 cu.in. cast iron per horsepower minute, compared with the usual 1½ to 2 for spiral mills with wide spaced teeth and ¾ to 1 for old style fine tooth cutters.

Front Rake on Blades. Very pronounced effect, but can be carried to only about 10 or 15 deg. in practice. Affects power as follows:

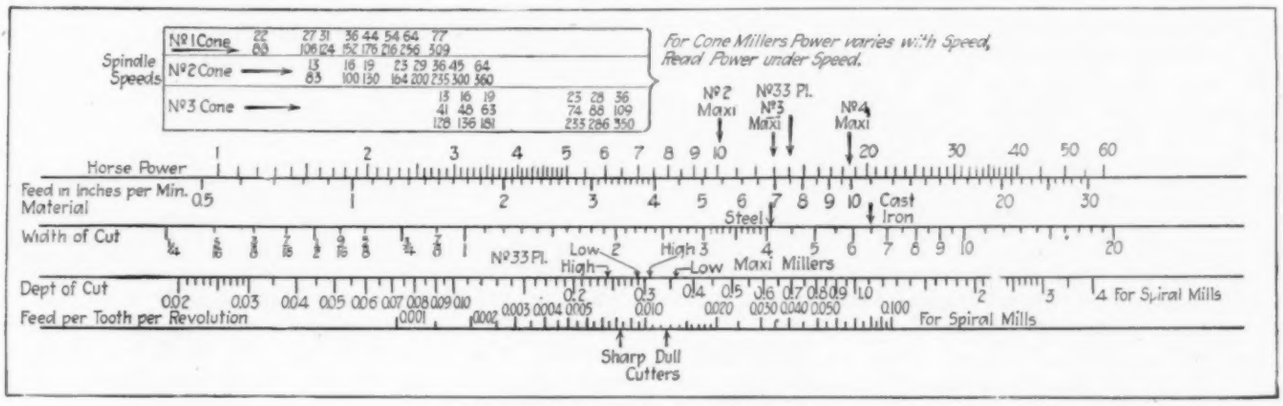
$$\left(\frac{\text{coversin 1}st\textit{ rake angle}}{\text{coversin 2}d\textit{ rake angle}}\right)^2 = \frac{1st\textit{ power}}{2d\textit{ power}}.$$

The above gives the following ratio of power required.

For 10 deg. rake, 1.00; for 15 deg. rake, 0.86.

Spiral Angle on Spiral Mills. The main effect of the spiral angle seems to be to reduce the bumping action of the cutter and reduce the strain on the machine and the tendency to chatter due to carrying load.

Judging from the fact that a load suddenly applied has twice the effect of a load applied gradually, it



POWER CONSUMED IN MILLING

appears that the peak of the load at the cutter might be twice as high, or even more, with a mill having straight teeth, and although this variation might be considerably reduced at the belt, due to the flywheel effect of gearing, etc., the best way to overcome it is to give plenty of spiral angle, or in gangs such as gear cutters where this is not possible, stagger the cutter faces so that no two are on one line. A 25-deg. spiral angle seems best, as this minimizes the "bump" and makes it unnecessary to nick the cutter to break the chip.

Cutting Speed. Peripheral speed of cutter seems to have no effect, but r.p.m. of cutter has an effect on power, as noted under *"Feed,"* in that it affects the "Feed per Tooth of Cutter." Other things being equal an increase in r.p.m. of cutter decreases the feed per tooth and increases the power in the following inverse relation:

$$\textit{For spiral mills } \left(\frac{r.p.m.}{R.P.M.}\right)^{0.5} = \frac{P}{p}.$$

$$\textit{For face mills } \left(\frac{r.p.m.}{R.P.M.}\right)^{0.4} = \frac{P}{p}.$$

Type of Cutter. Other things being equal there seems to be little difference in the power required at the cutter, whether for spiral mill or face mill. There is a difference however, especially noticeable on the smaller feeds and cuts in the belt horse power required for the feed mechanism when using spiral mills, due to the great table pressure set up.

When removing 12 cu. in. of cast iron per minute with a face mill at 8.7 in. feed, the power per cu. in. is almost exactly proportional to that for a spiral mill on a similar cut and feed. On a feed of only 4.4 in. the spiral mill takes more belt power than the face mill. Not enough data is available to state the ratio exactly.

Dulling of Cutter. Apparently very pronounced effect, and probably accounts for some wide variations in tests run thus far, and which are not otherwise accounted for. Not enough data to state ratio exactly, nor have we at present a standard for "dullness."

Conclusions

Conclusions reached are as follows:

(a) From the above it is possible to construct a slide rule showing with fair accuracy the power required for a cut under known conditions, and to determine therefrom which machine it should be run on, or conversely, what changes should be made in the conditions to run it on any given machine.

(b) Further tests will be run under conditions more suitable for establishing the above data exactly.

(c) Well designed cutters running at proper speeds and feeds may remove metal with four to six, or even more, times the economy of poorly designed cutters running at poor speeds and feeds, and still both may be within the limits of usual practice, and the difference in the appearance of the job would excite no comment. For instance on cast iron a cut ¼ x 6 x 4 in. feed = 6 cu. in. per min.

(1) An old style cutter with fine teeth, no front rake and somewhat larger diameter than necessary, might take 12 hp.

(2) A wide-spaced cutter, with 10-deg. rake, as small in diameter as possible, might take 6 hp. for the same spindle speed, or by reducing the r.p.m. to increase the thickness of chip, might take only 5½ hp.

(3) An inserted blade "maxi-cutter" spiral mill, same speed as (2) might take only 2.1 hp. This gives a ratio for (1) and (3) of nearly six to one, while if cutter (1) was dull this would be increased to seven or eight to one.

Not only may power be saved but the machines conserved in about the same proportion.

(d) A preliminary slide rule (see cut) embodying the above has been made up to be later revised according to results of special tests. The results are very satisfactory for spiral mills, somewhat less so for face mills, due probably to a lack of standardization of the corner radius. The table shows results by tests and slide rule over widely varying conditions.

(e) While all the above refers only to power consumed the paragraph "Effect of Dulling of Cutter" shows that it is very important that the useful life of the cutter under various conditions should also be investigated. Some data now available show that this follows laws entirely different from the above, and will require a separate slide rule, which can probably be later combined with the power slide rule to make a "Complete Miller Slide Rule" after the manner of the Barth-Taylor lathe and planer rules.

(f) It should be noted that least power may not mean best cutting conditions, as least power is required, other things being equal, for slowest r.p.m. of cutter, least teeth in cutter and greatest depth of cut (on spiral mills). This may increase the table pressure until the feed drive breaks or may cause poor finish due to large feed per tooth. Evidently the best cutting condition is a compromise on strength of feed drive, finish required, and cutting efficiency, or power.

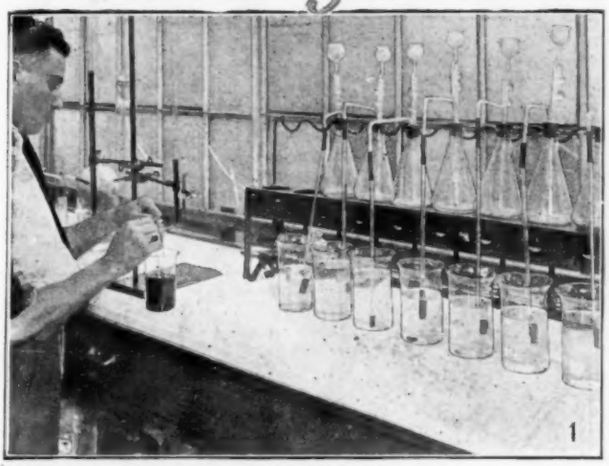
TESTS OF FIRST SLIDE RULE

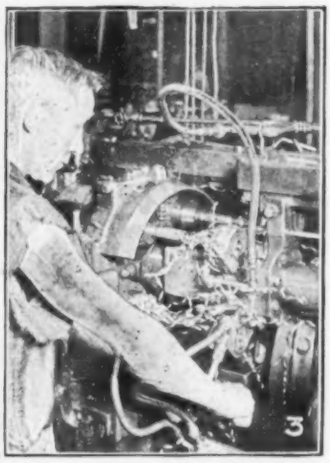
Material	Machine	Total Hp. by Test	Hp. by Slide Rule
Spiral Mills			
Cast iron	No. 4 Maxi.	14.10	14.20
Cast iron	No. 4 Maxi.	10.50	10.10
Cast iron	No. 4 Maxi.	3.30	3.20
Cast iron	No. 33 Prod.	5.30	5.80
Bar steel	No. 33 Prod.	7.00	10.50
Cast iron	No. 4 Maxi.	21.60	20.50
Cast iron	No. 4 Maxi	5.60	5.40
Cast iron	No. 4 Maxi.	26.50	25.50
Cast iron	No. 4 Maxi.	6.10	6.10
Cast iron	No. 4 Maxi.	9.00	9.20
Cast iron	No. 4 Maxi.	3.75	4.10
Face Mills			
Cast iron	No. 4 Maxi.	3.08	3.35
Cast iron	No. 4 Maxi.	4.30	4.20
Cast iron	No. 33 Prod.	3.60	2.35
Cast iron	No. 33 Prod.	5.70	4.10
Cast iron	No. 4 Maxi.	8.90	7.80
Cast iron	No. 4 Maxi.	6.50	6.30
Cast iron	No. 4 Maxi.	2.50	2.90
Cast iron	No. 4 Maxi.	4.45	4.70

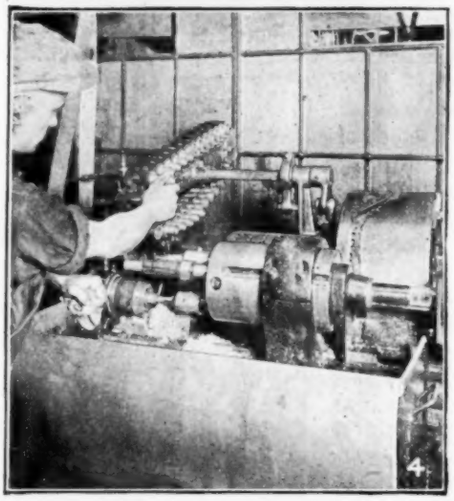
The above have not been especially chosen as corresponding either well or poorly, except that no test is included on which there is reason to doubt the accuracy of the actual horsepower figured from test. A wide variety of speeds, feeds and cuts are represented.

Washington's Pocket Knife a Relic.—One of the unique relics of American history still extant is the sixteen-blade pocket knife which was presented to George Washington by Captain Samuel DeWees in 1784. The knife was recently acquired by George DeWees of Chicago, a descendant of Captain DeWees. It is quite likely that the knife was of Sheffield origin, the best knives coming from there at that period.

Making the Essex Piston Pin

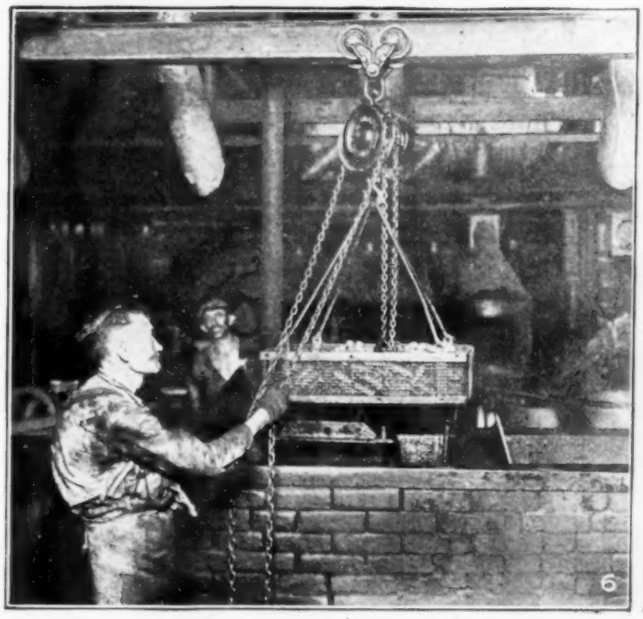






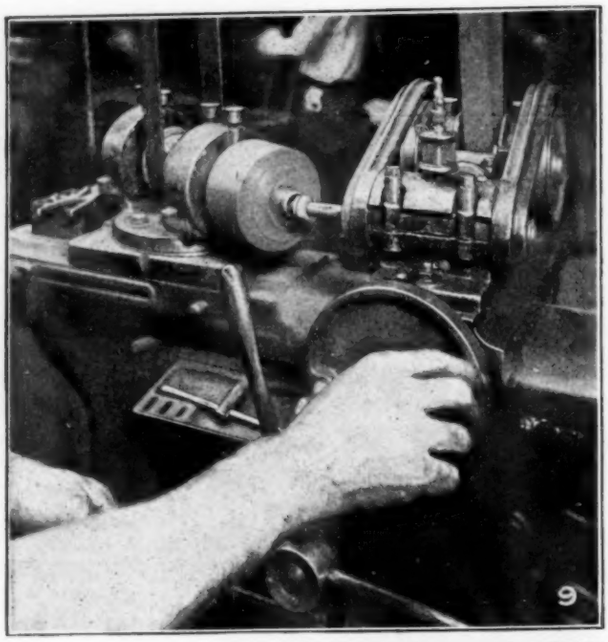
BY FRED H. COLVIN
Editor, *American Machinist*

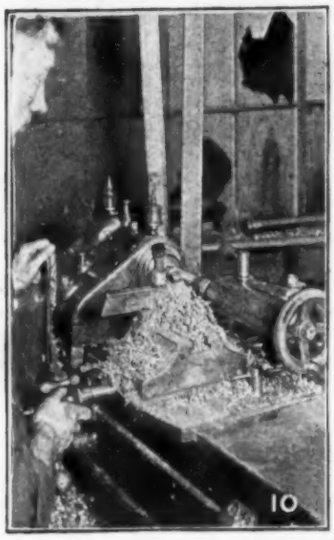
Few users of automobiles realize the details and the care necessary in producing satisfactory parts for their cars. This article gives a picture story of the making of a piston pin for the Essex motor and cannot fail to impress everyone as to the care taken in motor construction. Very little text is required, the pictures telling their own story to a large extent.



FIGS. 1 TO 7. THESE VIEWS SHOW SOME OF THE FIRST OPERATIONS

Fig. 1.—The Laboratory Analysis. Fig. 2.—The Stock Racks. Fig. 3.—First Screw Machine Operation. Fig. 4.—The Second Operation. Fig. 5.—A Quenching Process. Fig. 6.—Basket for Handling. Fig. 7.—Sandblasting Machine.

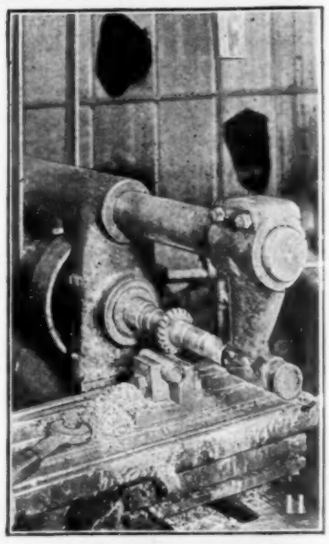


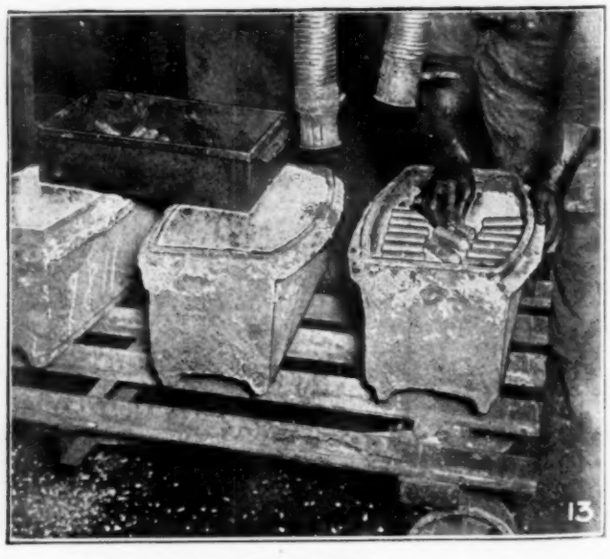


BEGINNING with the laboratory analysis of the steel to be used, Fig. 1, the accepted steel goes to the storage rack shown in Fig. 2, and is taken from here to the first screw machine operation as in Fig. 3, where a National-Acme multiple-spindle automatic is facing, drilling, turning and cutting off.

The second operation is done in a single-spindle Cleveland automatic with the magazine feed as shown in Fig. 4.

Then come the various heat-treating operations as shown in Figs. 5 to 8. These operations include heating and quenching, sandblasting and washing in a hot bath. The handling apparatus for this is rather unusual and interesting, as it consists of three arms mounted on a central post, the arms being equipped with air hoists so as to raise and lower the cradle when it is swung into position over the tank of hot liquid.



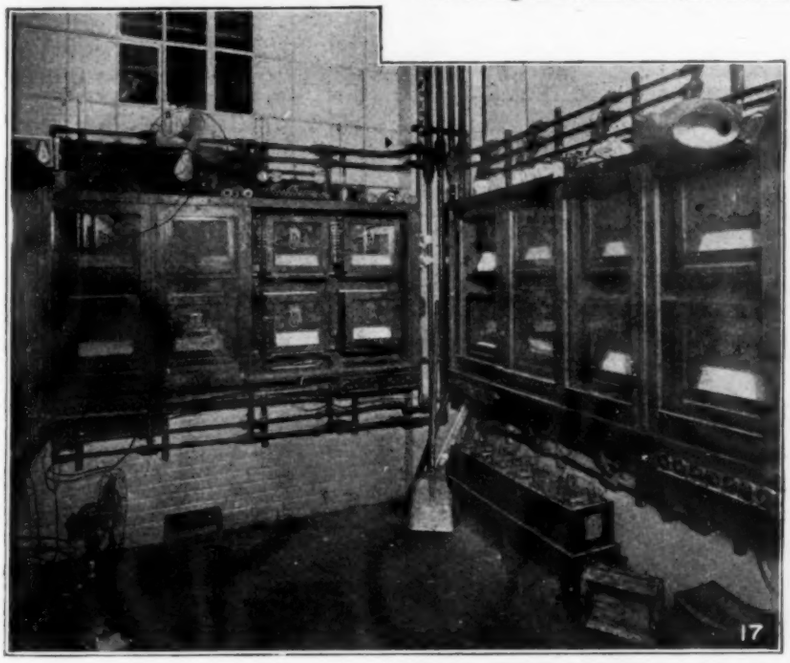


FIGS. 8 TO 13. HEAT-TREATING, GRINDING, AND TURNING OPERATIONS

Fig. 8—Handling in hot bath. Fig. 9—Grinding bevel in ends. Fig. 10—Finish-turning. Fig. 11—Grooving for clamp bolt. Fig. 12—Filling with sand. Fig. 13—Packing for carbonizing.

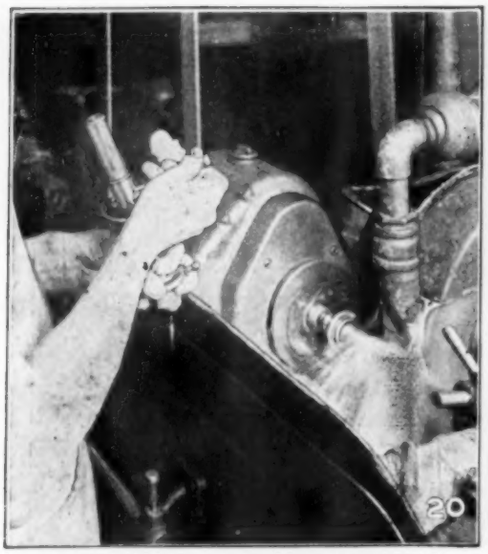
Then the machining operations begin once more, the end of the hole being beveled on a grinding machine so as to insure its running true in finish turning, as in Fig. 10.

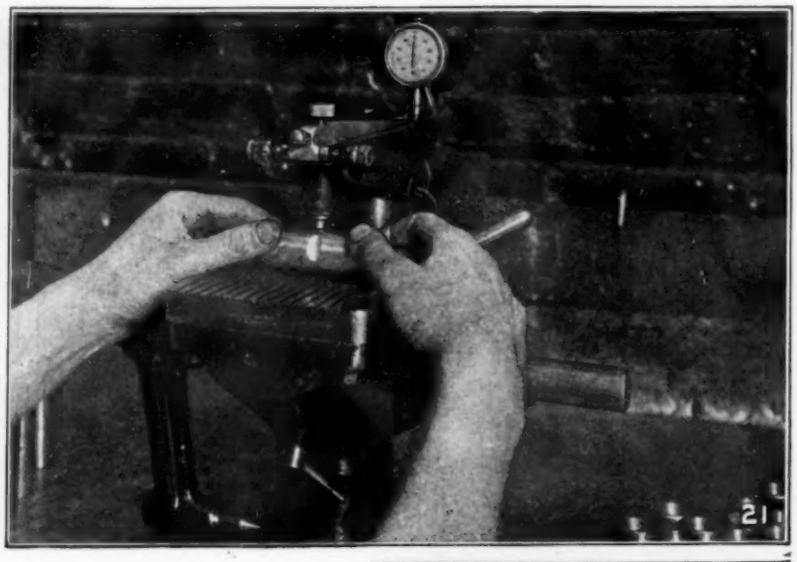
Next comes the milling of the groove for the cross screw for the clamping bolt, after which the pins are pack-hardened. The hardening operations are shown in Figs. 12 to 17. They include filling the center of the pins with sand, Fig. 12, and packing in carbonizing material as in Fig. 13. Fig. 14 shows the method of handling the carbonizing boxes, which makes it much easier for the men and saves them from close contact with the heat of the furnaces. The heating and quenching after the pack-hardening are shown in Figs. 15 and 16, while Fig. 17 shows a corner of the pyrometer room, where numerous Leeds and Northrup recording instruments are mounted.



FIGS. 14 TO 19. HEAT-TREATING, TESTING AND GRINDING

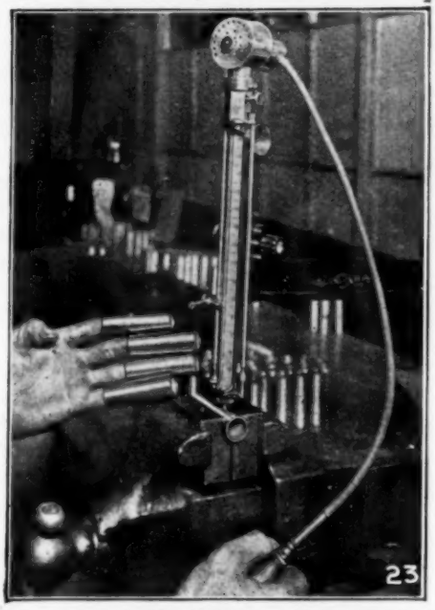
Fig. 14.—The Charging Machine. Fig. 15.—The Tempering Bath. Fig. 16.—Agitated Cooling Bath. Fig. 17.—The Pyrometer Room. Fig. 18.—The Brinell Test. Fig. 19.—Grinding the Groove.

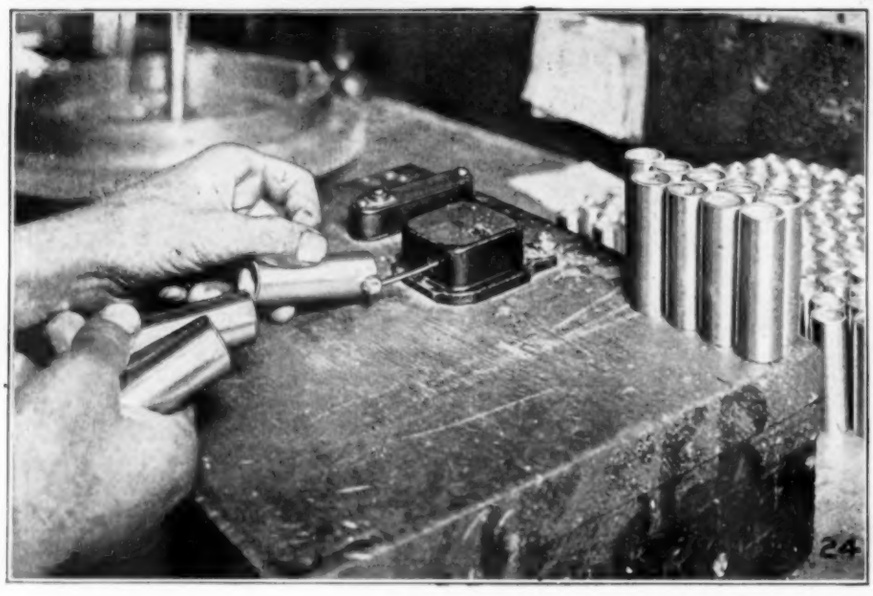


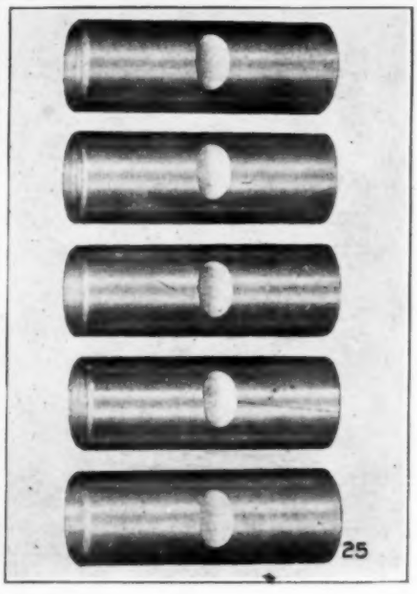


Next comes the Brinell hardness test in Fig. 18, grinding the groove in Fig. 19 and the finishing of the outside by grinding in Fig. 20. Inspections by two types of gaging instruments are shown in Figs. 21 and 22, multiplying levers being used, in both cases to secure extra fine measurements. Fig. 23 shows the scleroscope test with the pin held in special vise jaws, so as to insure uniform testing conditions.

Lastly the pin is tested for fire cracks by means of the electric vibrator shown in Fig. 24. A cracked pin gives out a very different sound from one which is perfect in every particular. Fig. 25 shows the finished pins.







FIGS. 20 TO 25. THE REMAINING OPERATIONS

Fig. 20.—Grinding the Outside. Fig. 21.—Gaging the Diameter. Fig. 22.—Another Multiplying Dial Gage. Fig. 23.—The Scleroscope Test. Fig. 24.—The Bell Test for Cracks. Fig. 25.—The Finished Pins.

Broaching Gas-Engine Tappet-Guide Holes

By J. V. HUNTER
Western Editor, *American Machinist*

A change in the finish-machining methods for tappet-guide holes in gas-engine cylinder blocks is being brought about by the introduction of a method of broaching in machines especially designed for this purpose.

SEVERAL conditions to be met with in the manufacture of cylinder blocks have combined to make the method of finishing tappet-guide holes by broaching preferable to that of reaming, and it is stated that the results obtained have been very satisfactory to the engine builder.

By the older method the operations included drilling, roughing and finish-reaming the holes, the rough reaming operations being necessitated by the close limits required as well as to save wear on the high-speed reamers used for the last cut.

For broaching, the holes are first drilled and rough-reamed and the final broaching operation finishes the holes to very close limits of accuracy. The limits of finish allowed are usually plus 0.001 in. and minus 0.000 in., or a total variation of 0.001 in.

Some engine builders claim that in finishing a hole of this character by reaming that the hole will be out of round as much as 0.001 in., even under average conditions. It is stated that by the use of round broaches where all of the cutting edges are engaged throughout the length of the cut, the concentricity of the holes will be maintained.

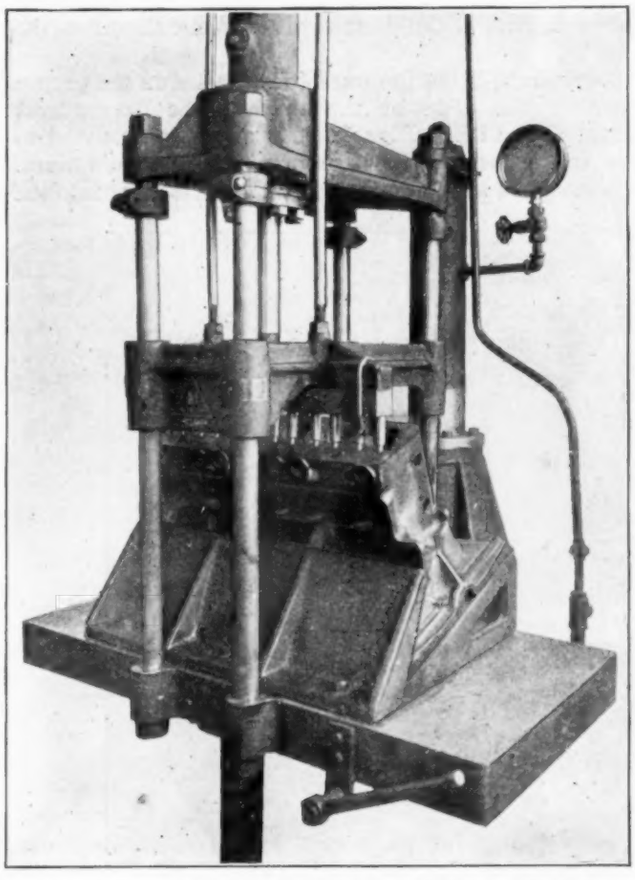


FIG. 1. CYLINDER BLOCK IN BROACHING POSITION

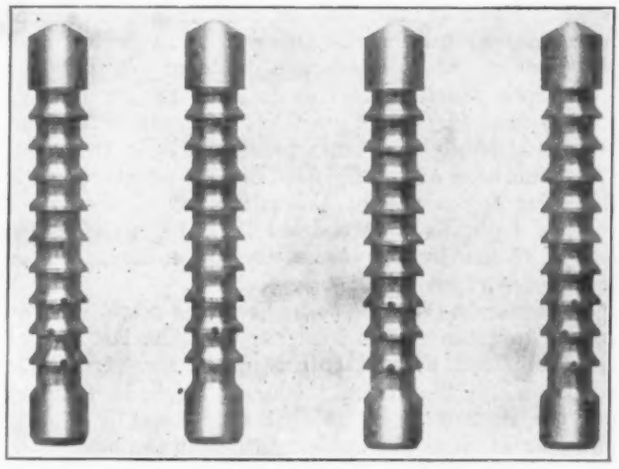


FIG. 2. TYPE OF BROACHES USED

The broaches are made to close limits and their ability to hold them with a minimum cost for tool upkeep is one of their greatest advantages. The average cost of broaches is stated to run about one-tenth the cost of reamers for the same amount of work and same grade of workmanship.

Therefore we find three claims advanced in advocacy of the broaching method, namely: First, accuracy and concentricity of the hole; second, extensive reductions in the tool upkeep cost; third, a slight saving in the time of the actual machining operation.

In the modern engine-building shop the cylinder blocks are transported on conveyor tracks to the broaching machines and then located in correct position relative to ram of the machine by suitable stops. The ram carries a broach head of a length sufficient to cover all of the tappet guide holes in the block, although it is customary to only broach the alternate holes, that is to handle six broaches at a time on a six cylinder engine block which will have twelve tappet-guide holes. However, this method is subject to some change and when broaching cylinder blocks in which the tappets are not evenly spaced, it is sometimes necessary to finish all the holes at the same time. A cylinder block in position underneath a broaching machine is shown in Fig. 1.

The broaches, Fig. 2, are used as loose tools and are dropped into each alternate tappet hole before lowering the broach-head. Upon conclusion of the ram's stroke the tools drop through into an oil pan underneath the machine, and for the remaining holes the operator uses a duplicate set of tools while his helper picks up those first used and cleans them. The cleaning is done by passing them rapidly between a pair of brushes which are attached to a block so that the brushes face one another. It is advisable to always have the broach tools well cleaned of chips.

The time for completely broaching a six-cylinder block in two strokes of the machine will be about one minute from floor to floor. This should be the average

time required, but of course, like all manufacturing operations, it varies somewhat with the ability of the individual operator.

The stroke of the ram is carefully regulated by speed valves which control the rate of flow of the liquid into the ram cylinder so as to obtain a uniform feed of the broach. However, this rate of feed is not dependent upon the operator, but is governed entirely by automatic valves. For the average grade of cylinder iron it has been found preferable to have the feed range from 12 to 16 ft. per minute, since this rate of feed has been found to give the best surface finish in the hole.

The condition of the finished surface of the metal is considered to be one of the points of advantage of broached holes, as it is claimed that the grain of the iron is closed by the formation of a hardened or burnished surface.

To accentuate this skin-coat effect it is sometimes the practice to make up the broaches with the last two or three rings left without cutting edges for burnishing, usually making them about 0.0003 in. larger in diameter than the cutting rings, so that they exert a slightly increased pressure when passing through the hole.

The best practice in desiging broaches requires that the annular cutting rings be ground with an established cutting angle of 1½ deg. and a clearance angle usually not less than 6 deg. nor more than 7½ deg. The lands do not exceed $\frac{1}{32}$ in. in width. Various grades of steel have been used for these tools, the preference depending entirely upon the individual shop. Some use high-speed steel, others high-carbon steel and still others are making them of a low-carbon steel and giving them a heavy "case" by the carbonizing process.

Drill Jig for Exhaust Manifold

By Fred H. Colvin

The illustrations show a somewhat unusual form of roll-over jig used for drilling the bolt holes in the flanges of the exhaust pipes for a Pierce-Arrow six-cylinder motor. This consists primarily of the body *A* having the disks *BB* at the ends, and carrying plates *CC* for centering the manifold at each end. The flanges of the manifold are placed face down in the fixture and the plates *DD* pushed over the flanges which are then bolted down by the bolts at *EE*. The drilling bushings are in the body of the jig, the holes in the holding plates *D* simply allowing the drills to pass through. The side outlet is drilled at *F*.

The details of this fixture can be seen in the three views in Fig. 2, the cross-sections being shown at the end.

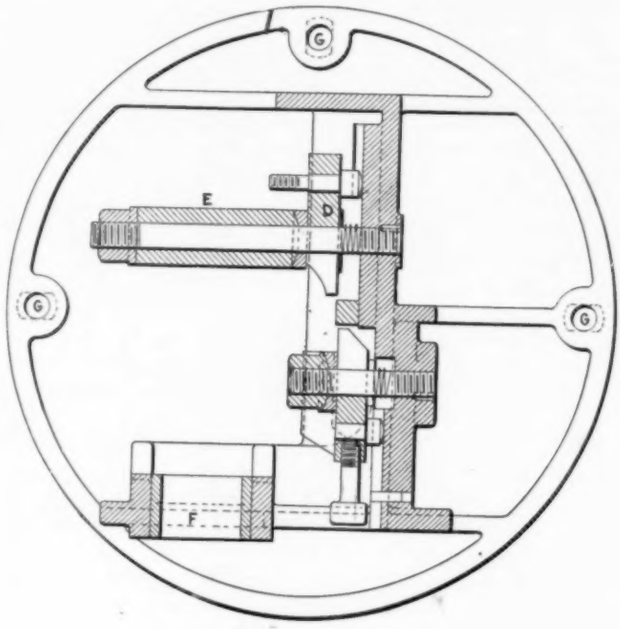


FIG. 3. CROSS-SECTION OF FIXTURE

In order to bring the work to be drilled in the proper position, the disks at the ends of the fixture rest on the rollers *RR* in Figs. 1 and 3, which are mounted on the rod shown in the base provided for the fixture. These rollers allow the work to be easily turned into the

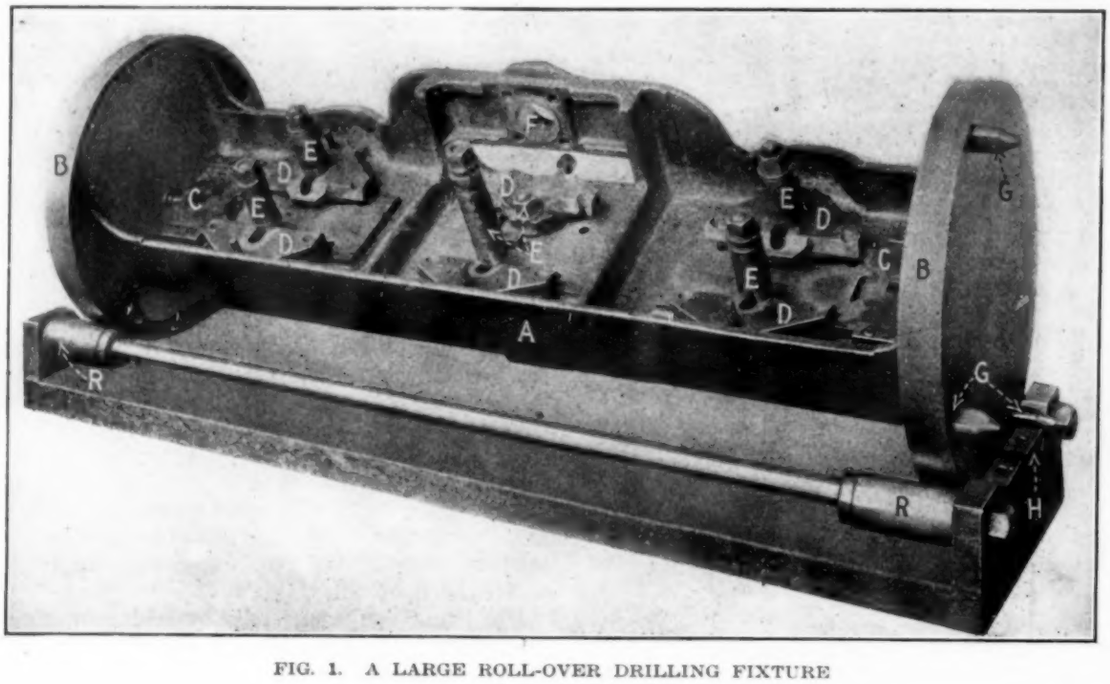


FIG. 1. A LARGE ROLL-OVER DRILLING FIXTURE

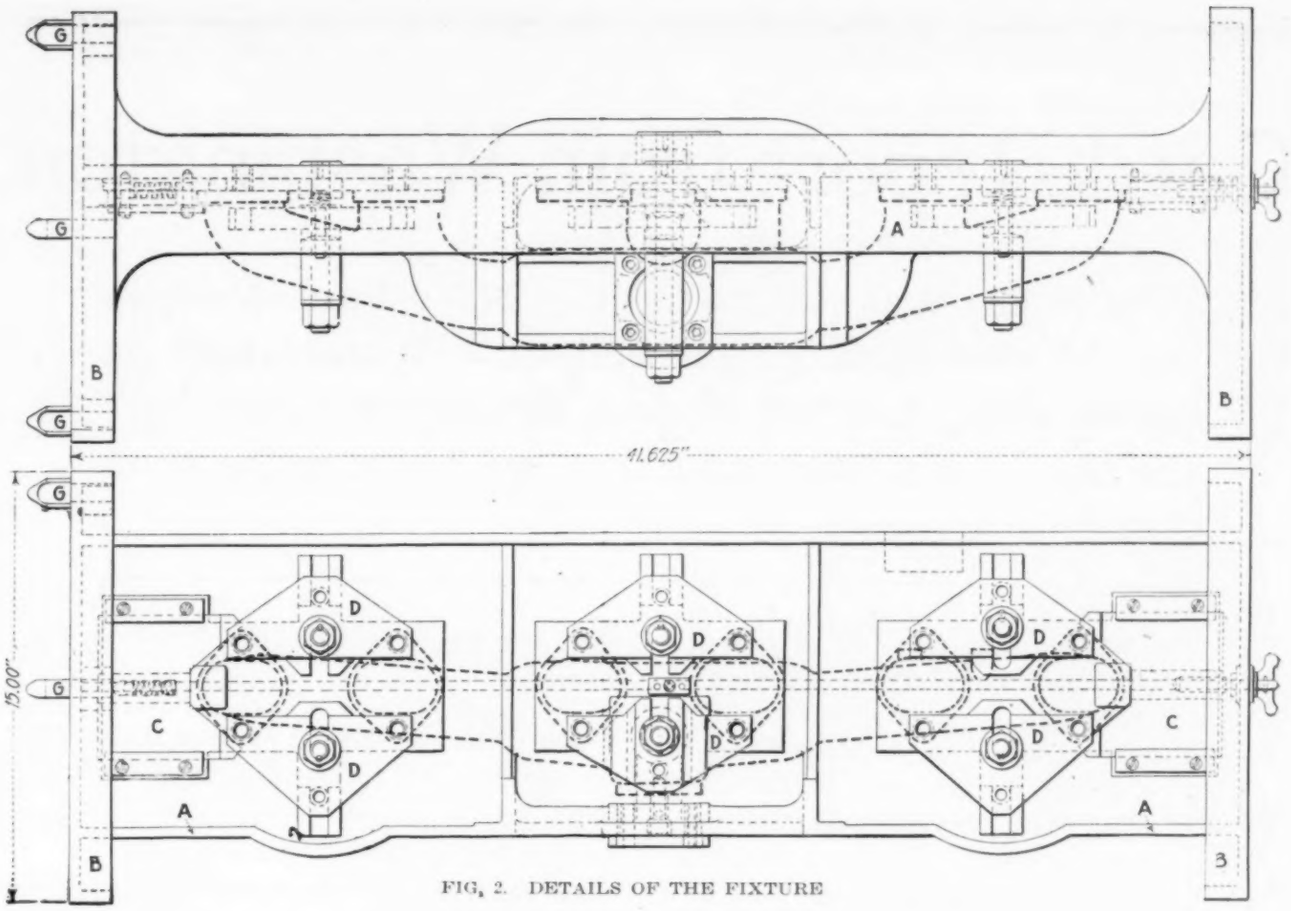


FIG. 2. DETAILS OF THE FIXTURE

desired position, while the three stops *G* afford a ready means of indexing by sliding them into the slot *H* at the end of the base. In order to make this easily handled, the rolls allow the whole fixture to be moved endwise with very little effort, thus engaging the indexing pins. The work is then turned to the desired position and the next stop slid into the opening *H*, which holds it very firmly during the drilling operation. The illustration gives the general proportions and sufficient detail to allow any desired modification to be made.

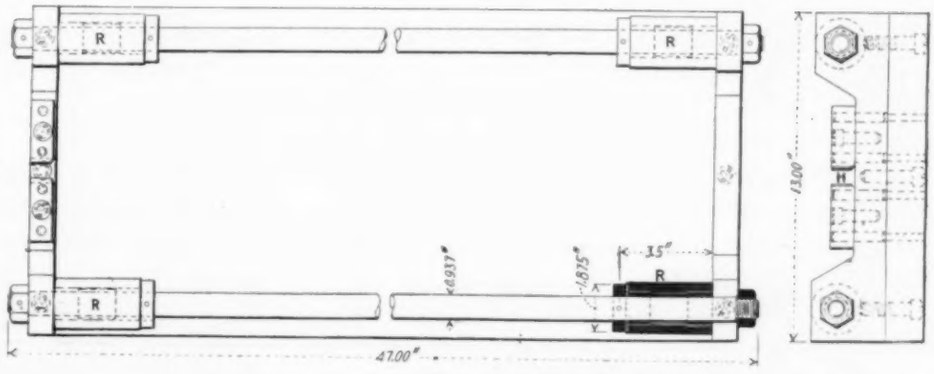


FIG. 4. THE BASE ON WHICH IT ROLLS

How to Keep Employees on the Job in Summer Time

By Charles D. Folsom, Jr.

The use of a bonus for keeping up attendance in the summer months was described on page 1365, vol. 52, of the *American Machinist*, by Frank H. Williams. Here is another method of meeting the problem, which is in use in the plant of Victor R. Browning &•Co., at College Point, N. Y.

Incidentally this was the idea of the employees themselves; they requested it by a petition, and the plan was put into effect at the beginning of June. It is planned to continue it throughout July and August. The shop had been working on the conventional forty-eight-hour week schedule, viz., 7:30 to 12:00, 12:45 to 5:00 and 7:30 to 12:00 on Saturdays. Realizing that, as Mr. Williams says, "Too frequently the Saturday half-holiday becomes an all-day holiday during the summer months . . .," the men desired to let it go at that by changing to a five-day week. The hours are now 7:00 to 12:00 and 12:30 to 5:00, making forty-seven and a half hours per week. This makes a rather long day, but nobody seems to notice the extra half-hour's work in the morning or the quarter hour less for lunch, so much as the half-day on Saturday.

There was, quite naturally, a little trouble at first with late-comers in the morning, but on the whole the new schedule operates smoothly. It appears to have solved the summer attendance problem satisfactorily to both the employees and the management, and without adding any additional burden to the company's payroll.

Card Report from Washington

This report was sent to us July 29, by Paul Wooton, our Washington correspondent. It certainly is encouraging, but our readers should not forget that the fight is not over, and that we must make such an overwhelming showing that the pro-metric advocates will be completely buried. For this reason send for more cards. They are absolutely free.

"Space is at a premium in the office building of the House of Representatives. The already limited floor space assigned to the Committee on Coinage, Weights and Measures is being further restricted by the steady encroachment of the *American Machinist* cards asking that the Committee take no action to make the metric system compulsory. All of the cards received are being carefully preserved. Thus far they have been accorded shelving space but since they are about to monopolize all of the Committee's shelf room, other arrangements are in contemplation which will preserve the cards and have them readily available for inspection.

One of the significant features in connection with the receipt of the cards is their contrast with the insignificant number of communications which are reaching the office at the suggestion of those who desire to see the metric system foisted upon the country.

While the number of cards being received has decreased considerably since Congress adjourned, they are still being received at the rate of about thirty per day."

Thos. Viall

Editor

Portable Electric Reboring Machine

By C. W. Geiger

A portable electric reboring machine, designed by Arthur S. Bacon, of Oakland, California, is shown in Fig. 1. It is claimed that by means of this machine 70 per cent of open-head automobile and tractor engine cylinders can be rebored without removing them from the block, and that any size cylinder can be handled.

The machine consists of base *A*, tapered centering cone *B*, boring head *C*, boring bar *D*, driving motor *E*, and flexible cable *F*. In preparation for boring, the base is set over the cylinder with the clamping bolts loose, the tapered centering cone is inserted and the base bolts tightened. The centering cone is then re-

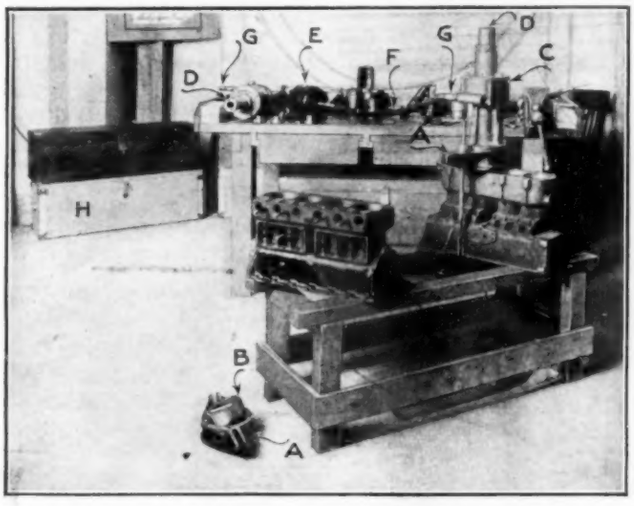


FIG. 1. PORTABLE ELECTRIC REBORING MACHINE

moved and the boring head and boring bar, with tool previously set for the cut, are placed in position on the base and tightened by four bolts. Roughing and finishing cuts are taken by different tools, each held in its own head. The base is centered with the bore by means of the centering cone. Four sizes of cones are furnished to care for the various sizes of the bore. With the base in position the boring head when applied is automatically centered with the base through a male and female joint.

The driving motor receives its power from any light socket. It is one-sixth horsepower, runs at 1,710 r.p.m. and operates the boring bar at a speed of 60 r.p.m. through a 7-ply wire flexible cable which is enclosed

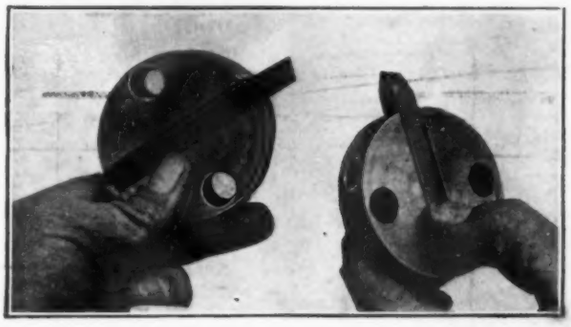


FIG. 2. INTERCHANGEABLE HEADS WITH ROUGHING AND FINISHING TOOLS

within a leather tube. The cable is connected to a completely encased worm gear on the boring head at *G* (Fig. 1) and may be withdrawn from it instantly and as quickly replaced. The motor is set on the floor or bench, as there is no necessity to anchor it.

The cut can be started at either top or bottom, a simple feeding arrangement being provided to feed in either direction, with feeds from 0.0083 in. to 0.0666 in. per revolution. The feed knockout is automatic.

The detachable cutter-heads with roughing and finishing tools are shown in Fig. 2. They are secured to the boring bar by two screws and a dowel pin. The tools are set by using the special micrometer, shown in Fig. 3, which is a part of the equipment of the machine. There is also a special chart for use in connection with the micrometer in setting the tools.

Some of the great advantages claimed for the machine are that it is not necessary to employ a skilled mechanic to operate it, the only skill required in addition to that necessary to grind and set the tools being the ability to use and read a micrometer; that on account of its light weight of 57 lb. it can be easily handled by one man; and that the entire equipment fits into a compact box such as the maker's shipping case shown at *H*, Fig. 1.

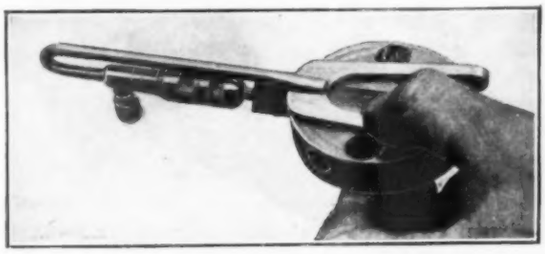


FIG. 3. SPECIAL MICROMETER FOR SETTING TOOLS

New Use for the Photostat

By Eward W. Theilig

In order to preserve a record of a special valve a photostatic print was made as shown in Fig. 1. The photostat was made full size and was then tacked down on the drawing board and the sectional drawing, Fig. 2, made with a minimum of labor and practically no measuring of the parts. The resulting tracing is all that can be desired as a matter of record, and the time required for its production was perhaps ⅒ of that which would have been required to lay out the parts in detail.

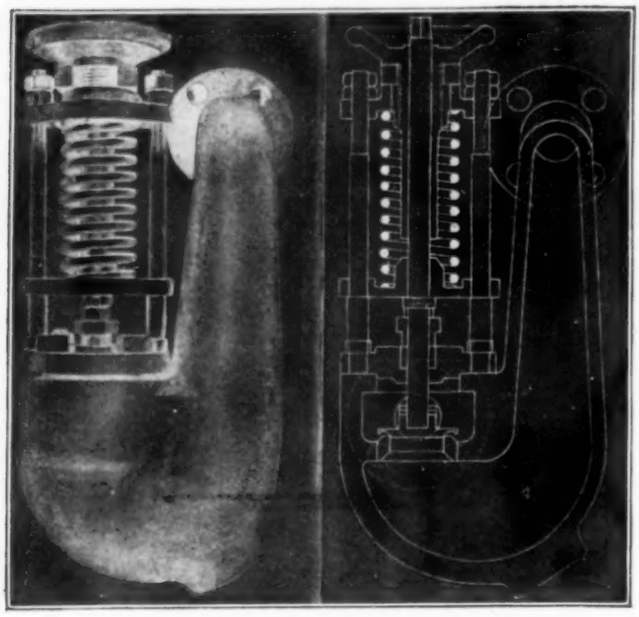
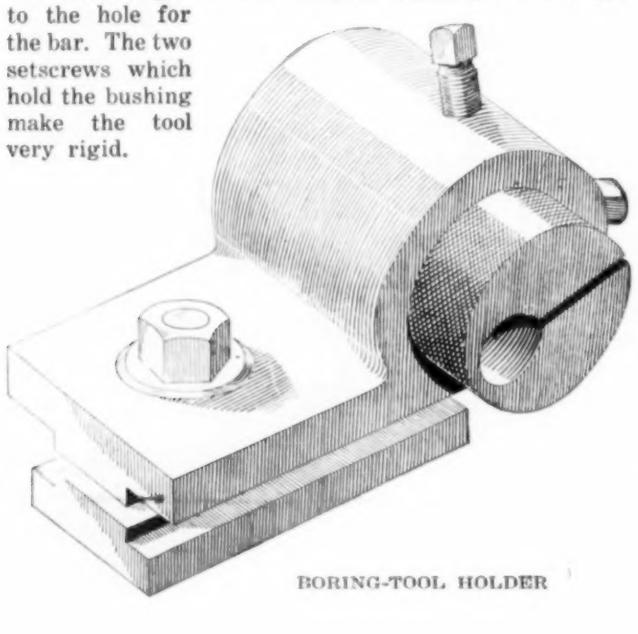


FIG. 1. PHOTOSTAT OF VALVE
FIG. 2. TRACING MADE FROM PHOTOSTATIC PRINT

Adjustable Boring-Bar Holder

By Joseph B. Murray

The illustration shows a boring-bar holder that can be adjusted for height by turning the eccentric bushing. The housing is of cast iron, the bushing is steel, split to the hole for the bar. The two setscrews which hold the bushing make the tool very rigid.



BORING-TOOL HOLDER

Grinding a Radius on a Gage

By Richard F. Moore

In making the gage shown in Fig. 1, it was necessary to figure out some way to grind the radius accurately.

As there were five gages on the order, I gave up the idea that first came to my mind of soldering them on to a plug or cylinder and made the fixture shown in Fig. 2. The V-blocks were already on hand. I finished the gage on every surface except the two ends, leaving about 0.006 in. on these. This eliminated the necessity of working to a dimension when grinding the radius. After the radius was finished the dimensions *A* and *B* Fig. 1 were ground to size. Fig. 2 shows the job set up in the grinding machine. The gage is brought central with the plug by figuring what dimension *C* Fig. 2 should be.

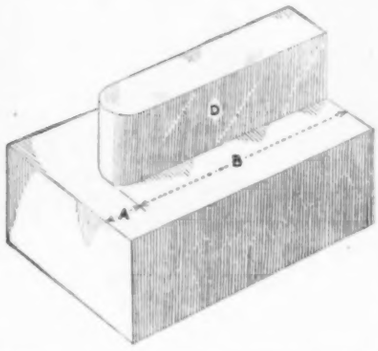


FIG. 1. THE GAGE TO BE GROUND

For example:

diameter of plug = 0.875 in.
Thickness of gage = 0.364 in.
0.511 ÷ 2
0.2555 in. size to make *C*.

The stops allow the plug to revolve just 180 deg. bringing the faces *D* parallel with the table.

After clamping a gage in position the fixture is placed on the magnetic chuck of a surface grinding machine with the long way of the block parallel with the cross feed. The fixture is then brought central with the spindle of the machine and the part to be ground put under the grinding wheel.

The wheel is then lowered until it begins to cut. Then the plug is turned backward and forward (by hand) and the feeding of the wheel continued until the wheel is the correct distance above the center line to give the required radius.

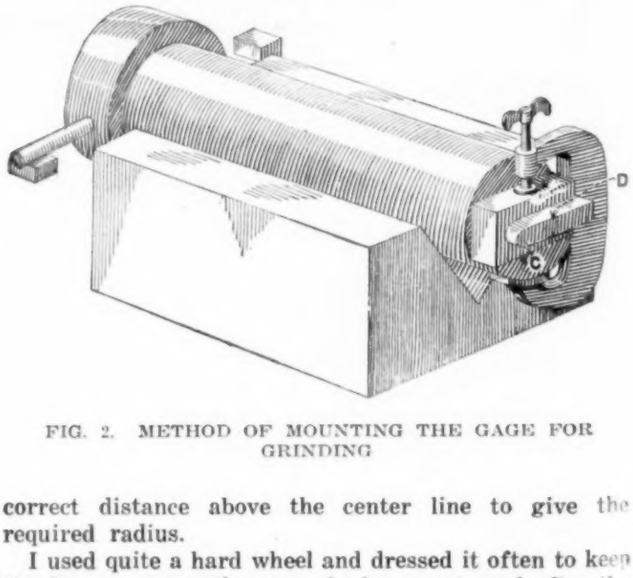


FIG. 2. METHOD OF MOUNTING THE GAGE FOR GRINDING

I used quite a hard wheel and dressed it often to keep the face square as the cross feed was not used after the fixture was located.

WHAT to READ —for the man in a hurry

Suggested by the Managing Editor

"MACHINING the Gear-Shaper Saddle" is the leading article. It is by Douglas T. Hamilton of the Fellows Gear Shaper Co. The author says that the saddle, next to the index wheel and worms, requires the most accurate machining. He then tells about the machining methods from the first operation, that of snagging and smoothing down the casting with a portable grinding machine, to the final operations of testing.

There has probably been much thought concerning the possibilities of successfully using steel belts; little, however, has been written. "An Experimental Investigation of Steel Belting" is the title of a paper by F. G. Hampton, C. F. Leh and W. E. Helmick, of Stanford University. The article goes into detail and it has been necessary to divide it into two parts, the second of which will appear in a later issue. Part I begins on page 298. Student and Junior prizes were awarded to the authors of this paper at the annual meeting of the American Society of Mechanical Engineers, held Dec. 2 to 5, 1919, in New York.

Every manufacturer, whether on a large or small scale, should know the exact quality of the goods he produces. Such a knowledge is secured from some form of inspection, though not always recognized as such. When the output is comparatively great, an independent department of inspection is necessary. "No inspection department that is not a paying unit of the whole organization can be considered a success," says O. B. Whittaker in "Inspection and the Modern Factory," page 305. He continues: "The great variety of ways in which inspection brings about a saving requires the closest study of each individual case . . . The cost of incorrect fulfillment of a contract on deliveries, or the indirect damage done by the delivery of a faulty product, can never be fully determined." As a reciprocal statement, neither can the value of prompt deliveries and faith of the customer be accurately estimated. Some very good points are brought out by the author.

H. H. Manchester's twelfth installment on the "Evolution of the Workshop" is up to the usual interest standard of this series. The current article deals with the development which took place in the metal-working industries of Great Britain during the period between 1820 and 1870. One of the author's quotations serves very well to convey the spirit of the article: "Lathes are now made in . . . . Europe that will turn with ease a mass of fifty tons in weight, or as many feet in length; planing machines that will bring to truth and flatness surfaces of 40 x 10 or 12 ft. . . . steam hammers of twenty tons and upwards, falling twelve feet, whose blow at a distance is felt as that of an earthquake." Page 311.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

There is an interesting treatise by Fred. A. Parsons, Chief Engineer of the Kempsmith Manufacturing Co. on "Power Consumed in Milling." The experiments which furnish the basis of this report were undertaken to secure data for the construction of a slide rule by which could be determined the power required for a given job. One of the author's conclusions is that: "Well designed cutters running at proper speeds and feeds may remove metal with four or six, or even more, times the economy of poorly designed cutters running at poor speeds and feeds, and still both may be within the limits of usual practice and the difference in the appearances of the jobs would excite no comment." Page 315.

Another of Fred Colvin's automotive articles is given —page 317—dealing with "Making the Essex Piston Pin." It is a story presented by 25 half-tones and some 300 words—easily, but profitably, read.

Western Editor Hunter takes up the broaching method of finishing tappet-guide holes in gas-engine cylinder blocks. He presents the details of this method and compares them with those of the older method of reaming. He also has some things to say regarding the design of the broaches and their cost when compared to that of reamers. The article begins on page 321.

"Card Report from Washington" is the heading Editor Viall used for his editorial on page 324. He might equally well have written "News from the Front." Yes, the news is "good" but won't you take his advice and help to make it "splendid."

EDITORIALS

Encouraging Reports of Increased Production

THE publication by the Manufacturers Association of letters showing an increase in production in their factories is encouraging, whatever the cause. It is the sign of a tendency to return to normal conditions which can be interpreted in various ways. But is it not natural that it should be so?

The unreal and unnatural conditions of the war, the talk of fabulous profits and the great demand for labor, all tended to cause a decrease in effort as a natural reaction.

There is every reason to believe that production will continue to increase, particularly in places where the management is making an earnest effort to promote a better understanding with its men. For such efforts must come from the top, they can hardly start in any other way. Exaggerated ideas of profits too often exist because no effort has been made to let the men know the facts in the case.

As one manufacturer in the great Northwest remarked, "we have shown our men too little of our ledgers and too much of our limousines" so that it is but natural that ideas as to profits should be somewhat out of proportion to the facts in many cases. Nor must we overlook the fact that abnormal profits have been made in many cases, as shown by published statements of dividends, both in cash and in stock. That these all have their effect is admitted by all who study the situation carefully.

The trend of the letters quoted is to credit the increased production to specific items such as piece work, open shop, etc. Observations of specially successful shops, however, do not point to any one panacea for our industrial ills. Good and bad shops can be found using practically the same systems. One uses piece work and bonus with great success. Another has secured almost identical results with straight day work and no bonus of any kind.

We all know of shops without any apparent system which get along without difficulty, and of others with elaborate systems which fail completely because of a lack of confidence and harmony.

The average man in the shop and the average manager are both square and mean to play the game fairly, as they see it. The point of view is too often warped by lack of knowledge and understanding of the problems of the other side. The sooner we make a determined effort to get together, to see what the problems really are and to face them fairly, the sooner will we get back to normal production—and beyond. But pressure or coercion on either side will not accomplish the desired result.

It may appear to win for a time, but resentment remains and prevents any real harmony. An armed truce, with either side waiting for an opportune time to attack, is not conducive of the kind of co-operation which makes for increased production.

Now that the tide of production has started to flow in the proper direction let us encourage it by such sane and helpful methods as will increase confidence in the claim that the interests of both men and management are the same. Let us show that both sides are getting a fair share of the value of the product and so refute all claims to the contrary.

F. H. C.

Technical Press or Engineering Society?

HOW far should the engineering society go in collecting actual shop data and methods for the benefit of its members? Aside from the matter of standards, which is admittedly an engineering question, how much of such material can be handled by an engineering society to better advantage than it is now handled by the trade and technical press?

In connection with the Production Session at the spring meeting of the Society of Automotive Engineers, a circular letter was sent out to a selected list. This letter asked how the society could best aid in the solution of industrial problems.

Two of the answers are worthy of attention. One of them makes the following suggestion: "Compile data with regard to manufacturing methods used in production of automobile, truck and tractor parts. This data to include type of machines used, kind of fixtures, tool equipment, details of motion and time studies and the quantity produced in a certain time."

The other recommends "the establishment of a bureau or clearing house for troubles that pertain to the automotive industry and for outlines of machine operations, machines, tools and fixtures that have proved successful for some particular job. * * * this would eliminate one manufacturer going over the same ground with the same idea that has been proved inefficient."

A combination of these two recommendations will give a very fair statement of the policy of the *American Machinist* toward the whole machine industry and not only the automotive branch of it. If they had been written after a careful reading of this and other technical papers, we would have very little to say, but we do not believe that this is the case.

We have only to refer to the comparative automotive shop practice articles which have been running for the last few months to give one instance of the presentation of exactly the type of material suggested. Our contention is that the trade paper is the proper medium for the supplying of this sort of information. This is not to be interpreted as any sort of a reflection on any one of our great national engineering societies, for we have a lively appreciation of the value of the work they are doing.

It is simply to indicate our feeling that our staff of shop experts, trained to secure and prepare just such data, can handle the material in question at least as well and more expeditiously.

K. H. C.

Legislators vs. Manufacturers and Engineers

EVERY once in awhile some man or group of men, with more enthusiasm than practical knowledge, attempts to regulate, or change by law, certain conditions in the industrial field. They half guess at a situation, multiply this by two, and proceed to pursuade some affable, or gullible, legislator to introduce a "reform" bill of some sort.

As an example of such procedure, we again call attention to the attempts of the "World Standardization Council" alias the "World Trade Club," etc., etc., to "reform" our measuring system and force through a compulsory metric law.

No one with the slightest knowledge of our domestic and foreign trade industrial conditions would ever seriously attempt such a thing. To pass any law affecting industrial conditions, fostered only by enthusiastic theorists, would be the height of folly. We have frequently urged the need of successful engineers and business men in Congress in order to prevent foolish legislation and to introduce constructive legislation. However, any attempt to change our present system of measurement should never be started from the legislative end. If any change or standardization is necessary, the proper way to begin is to have the great engineering societies and manufacturing associations work the problems out in conjunction. When so worked out the results will FIT industrial conditions and will need no law to enforce their adoption.

A shining example of engineers and manufacturers working hand and hand to bring about desirable standardization is that of the Society of Automotive Engineers. No legislation has been, or ever will be, needed to bring about the adoption of the standards decided upon by the special committees of this society. Proposed standards are thrashed out in conferences of practical production men and a tremendous amount of constructive standardization of automotive parts and accessories has been brought about.

There is no doubt that certain standards should be incorporated in our present system of measurement in order to bring about greater uniformity in units used by the English speaking nations—and which, if adopted by them, the rest of the world would quickly follow.

However, such standardization has its logical starting point with manufacturers and engineers and NOT with legislators.

E. V.

Workers to the Rescue

A SPECIAL dispatch to one of the New York daily papers a few days ago said that the 11,000 employees of the Philadelphia Rapid Transit Co. have offered their combined savings of more than $500,000 to President Thomas E. Mitten, as a loan without interest to be used to tide the company over financial difficulties. Not only this, but they offered their future savings and agreed to forego collecting the increase in wages (automatically due them at this time) until Mr. Mitten shall have found sufficient financial backing to carry on his fight against interests that are opposing his policy of not increasing the fares. While the majority of the board have upheld Mr. Mitten, unfortunately, the few who disagreed and resigned from the board were the financial backers of the company.

Why have the employees of such a great street-railway system come to its rescue? Do they not belong to a union—a very great union? Does their union teach actions such as they are credited with? Would Sam Gompers et al have advised them to take such a step? Have they done this for fear the company might be forced into bankruptcy and they would lose their jobs?

The reason for this fine and loyal action on the part of the 11,000 employees of the Philadelphia Rapid Transit Co. is a very simple one. It is because Thomas E. Mitten has at all times been absolutely *fair* with them and has always laid all his cards on the table, face upward.

Mr. Mitten came to the Philadelphia Rapid Transit Co. at a time when the efficiency of the system was at a very low ebb and was suffering the after effects of a costly and disastrous strike—at a time when many predicted that it was more in need of an undertaker than a doctor—and behold the results. Mr. Mitten by fair dealing made his men loyal to him and a leader with loyal men to back him can do almost anything.

We do not think this case should be without a parallel —or many parallels. We are believers in the American workingmen and we believe that if all of them were treated as Mr. Mitten has treated his men, all opposition to employers would cease and strikes would no longer be prevalent.

All honor to the 11,000 loyal employees of the Philadelphia Rapid Transit Co.—"They have builded better than they knew."

S. A. H.

Factory Bulletins That Count

THE Factory Bulletin in the June, 1920, issue of the *Wigwam*, the house publication of the Spreckles "Savage" Tire Co., contains the following pertinent and helpful paragraphs:

Notice of Leaving

Do not wait until the last minute to give notice of leaving. If you are thinking of leaving, talk the matter over with your foreman. Leave a good feeling behind. You may want to come back some time.

Kicks

Any employee having kicks or complaints make them within the four walls of the plant.

It often does good to kick in the plant to the proper authority. It never does any good to kick outside. Put your kicks in the form of suggestions and drop them into the suggestion box.

Don't Dodge Responsibility

Dodging responsibility is a senseless habit that started way back in the Garden of Eden when Adam blamed Eve for tempting him to eat the apple and Eve in turn blamed the serpent. If mistakes have been made, be honest and manly about it. Admit your part and the part your men have in making them. It saves long arguments and puts you in the right light.

Increased Salaries

The young man who would be successful should remember one special thing. Make yourself responsible for something—responsibility is what counts.

You will find that a business will give you back just what you put into it. The cash in advance idea does not prevail in any business any more than in life. The code letters for increased salaries are "C. O. D."

F. H. C.

What Other Editors Think

A Transportation Experiment

From *Iron Age*

THE Transportation Act of Feb. 28, 1920, was less than three months old when an experiment on a very large scale was begun under it. With the new powers granted it by the act, the Interstate Commerce Commission is endeavoring to effect the movement of the commodities that most affect the public and to reduce a traffic congestion that has been throttling manufacturing and commerce generally. This is an experiment of the most vital importance.

For years we have been wondering what we ought to do with our railroads. After much discussion the new transportation law was enacted, and the act has been very generally approved. If conditions do not prove satisfactory, the experiment of Government operation can hardly be avoided. The present transportation act, in the opinion of men who have followed the subject closely, provides the only trial that can be expected of private ownership and operation of the railroads. All developments in this trial, therefore, are to be watched with the greatest interest.

The Interstate Commerce Commission's present effort to improve traffic conditions was undertaken after leading railroad executives had asked the commission to act, but the new law gives the commission the power to act without such request. The language of the law regarding car service rules, routing, etc., is: "Whenever the commission is of opinion that shortage of equipment, congestion of traffic, or other emergency requiring immediate action exists" it may proceed at once, being answerable to no one, and money penalties are designated for failure of carriers to obey orders.

The commission has its own observers in the field, it has the advice of railroad executives, and it is in close touch with shipping interests and their traffic managers, who are able to give important information and advice. Thus the experiment is a crucial one, and if there is failure, no fresh experiment of this general character can be proposed.

The shippers of the country wish the Interstate Commerce Commission success in this operation and entertain definite expectations that sufficient improvement in traffic conditions will result to make it clear that the powers provided by the transportation act are useful. Success of the experiment as an experiment does not require that the traffic congestion be ended entirely, but that a reasonable improvement be seen.

If these efforts succeed, the success will show that strikes by railroad operatives cannot be as effective with the new transportation act in force as they would have been under former conditions. That would be a separate and distinct advantage in the matter of strikes being avoided, apart from the requirement of Section 301, that "it shall be the duty of all carriers, and their officers, employees and agents, to exert every reasonable effort and adopt every available means to avoid any interruption to the operation of any carrier growing out of any dispute between the carrier and the employees or subordinate officials thereof."

The amount of idleness of workmen at the present time is such as justify expectations that a noticeable change in the mental attitude of labor generally will be produced. For a long time, the job has sought the man, and workmen all seemed convinced that they need have no care for themselves, that wages would always be offered for any degree of performance they chose to offer. And the complaint has been heard several times lately that the iron and steel industry has not helped in its taking into employment numbers of the striking railroad workers. These last are without strike benefits and without a voice in the councils of the Railroad Labor Board. In each of several industrial centers, tens of thousands of men are idle as a result of the railroad strike, while there are various separate strikes, many of which do not promise results satisfactory to the men. In some quarters, it has been urged for months past that labor needs "the rest cure" through there being a period of industrial inactivity. Such a cure is now being taken by not a few men and were it a case of a little leaven leavening the whole loaf, the results, as to more efficient and enthusiastic labor performance in future, would not be in doubt.

The Alien Influence

From the *Cincinnati Enquirer*

SHOULD someone have the time and the Joblike patience needed to investigate the countless instances of trouble that rise between employer and employee he would find that in a surprising number of cases the dissension is due not to the general dissatisfaction of the men themselves but to the fomenting efforts of an outsider.

Left to themselves a group of men almost invariably will take sincere action to settle disputes through the only fair and sane medium, arbitration. It is the professional organizer, the paid agitator, the so-called walking delegate, who skillfully plays upon the sympathies of the men, kneads them into a milling crowd and finally prevails upon them to scoff at the quiet measures of the council table.

Most of all to be regretted is that the organizer, sent more often than not from a central office of a union for the express purpose of stirring up dissent, knows all too little about the local conditions to which the men are subjected. He knows nothing of their needs or of those of their employer. He is ignorant of the humor of the public, that mighty force, and neither has he adequate knowledge of its needs. He has founded on a commercial basis for his own personal advantage the art of trouble making.

That American citizens will submit indefinitely to having such parasitical producers of nothing but upheaval gain their livelihood at the expense of the public weal is a false assumption. They are of no use to society. They tear down. Like a destructive fire, they should be extinguished.

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

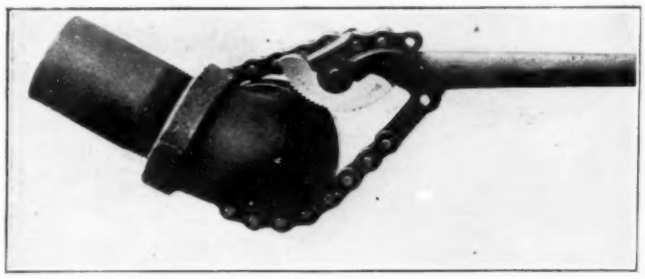
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Falcon Pipe and Fitting Wrench

J. H. Williams & Co., Brooklyn, N. Y., has added to its line the Falcon wrench shown in the illustration. The wrench has a wide range of application and is particularly adapted for work on pipe fittings. The curved jaw is solid across the center but has open ends, the face resembling somewhat the letter H. It is claimed that this design affords several advantages, among which are that the open end will straddle the corner of an awkward fitting, while the solid center may be used as a thin flange, and that the solid, one-piece jaw cannot spread.

The curved face of the jaw allows an effective grip with three shifts of the chain links and also permits



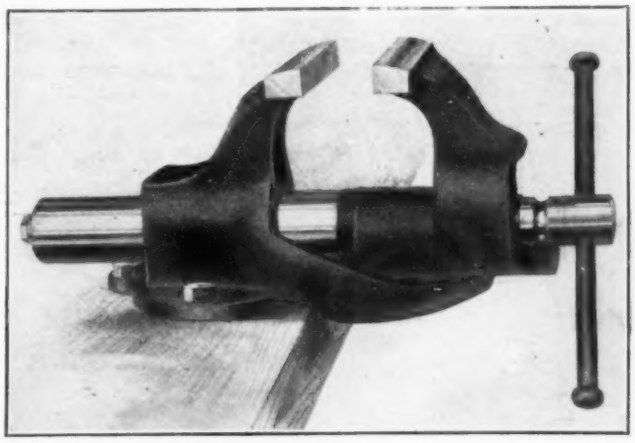
FALCON PIPE AND FITTING WRENCH

work in close quarters, such as connecting radiator pipes. The wrench is designed for one-way operation, consequently there is no chance for confusion when hurried. When the jaw becomes dull its position may be reversed by driving out the holding pin, thus doubling its life. The jaw is made from tool steel and the lever from 0.45 per cent carbon steel. The wrench is made in six sizes, covering all sizes of pipe from ½ to 12 inches.

Soderfors "All-Steel" Vise

The illustration shows a vise made by the Soderfors Bruks, Falun, Sweden, and recently introduced in the United States by V. Lowener, 114 Liberty St., New York City.

The main parts are made of Dannemora special alloy steel, which is claimed to be stronger and tougher than chisel steel. The stationary jaw is an intregal part of the body. The movable-jaw body is round and fits closely in a hole in the main body, insuring parallelism of the jaws. The screw and nut are said to be made of a special long-wearing alloy steel. The vises are made in eight sizes and can be furnished with either

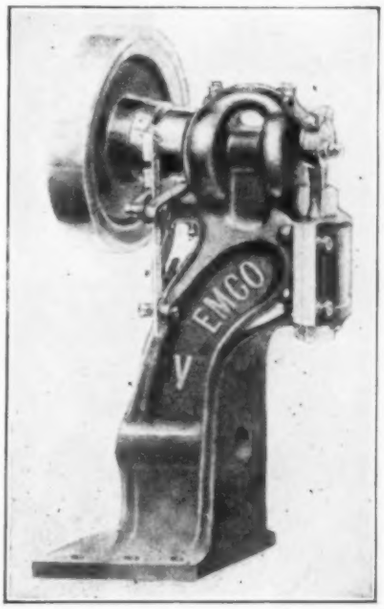


SODERFORS ALL-STEEL VISE

plain or swivel bases. The jaw widths of the various sizes range from 3½ to 8⅞ in. and the weights with plain base from 11 to 200 lb. With swivel base from 13½ to 250 pounds.

"Emco" Bench Horn Press

The Enterprise Machinery Co., 30 South Clinton St., Chicago, Ill., has added to its line the bench horn press, shown in the accompanying illustration and known as type "V." The press is intended for rapid production in the assembling of small parts and for operations such as seaming and riveting on hollow work.



"EMCO" TYPE "V" BENCH HORN PRESS

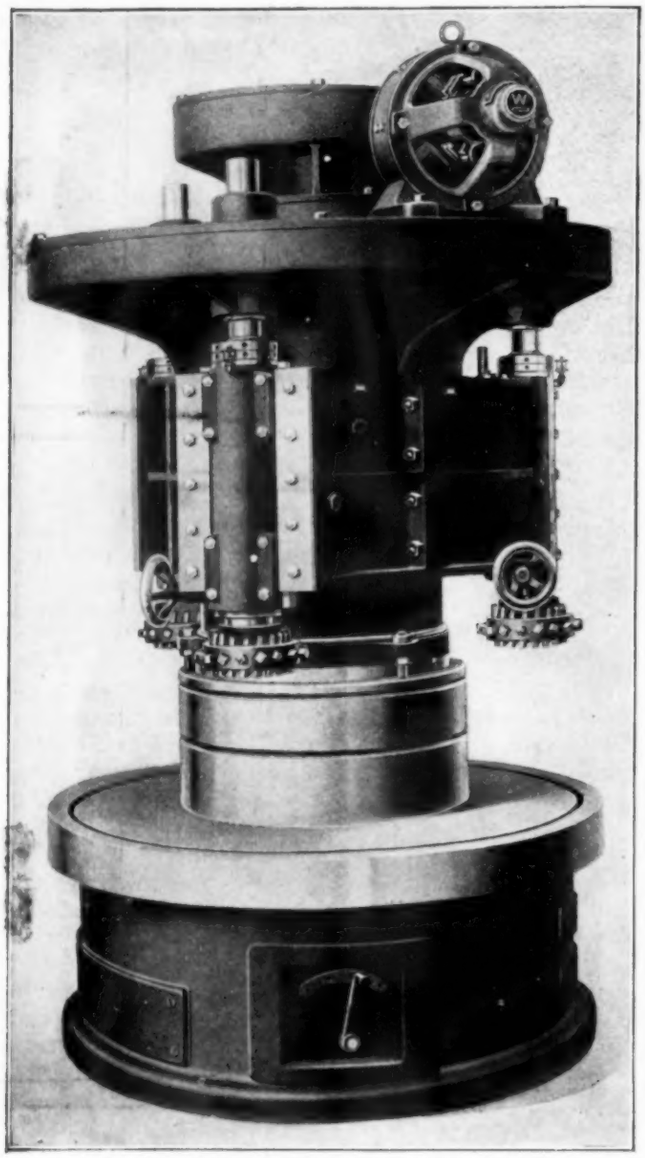
The machine has a single-stop stroke and is made with strokes of ¾, 1¼ and 1¾ in. The ram is 1⅜ in. square and has an adjustment of ½ in. The horn hole is 1⅞ in. diameter. The press is 26 in. high, runs at 300 r.p.m. and weighs 130 lb.

Betts Multiple-Spindle Continuous Vertical Milling Machine

The multiple-spindle continuous vertical milling machine here illustrated is being built by the Betts Machine Co., Rochester, New York. The machine is intended for heavy production milling on duplicate parts and is of simple and rigid construction.

It is provided with three spindles, but can be furnished with additional spindles if required. The four-spindle machine may be fitted with two roughing cutters and two finishing cutters. The spindles are steel forgings, driven through long splines and spur gears, and they may be adjusted vertically by hand. The machine may be driven either from a pulley or by an individual electric motor at the top of the machine.

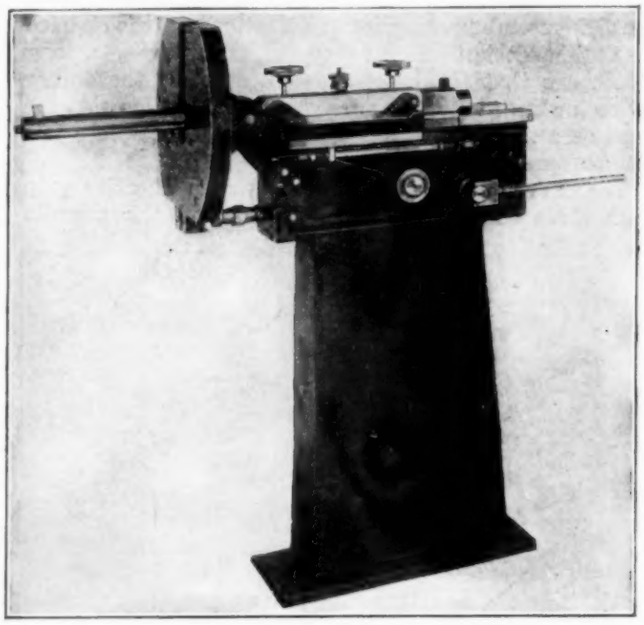
The work-holding fixtures are carried on the continuously revolving table, and the pieces are changed while the fixture is passing from one cutter to the next. The table has a flat bearing on the bed, and a split tapered bushing provides for taking up wear in the bearing on which the table revolves about the column. The table is driven through a large internal gear, all bearings being bronze-bushed and all gears running in oil. Four rates of continuous feed are obtained through sliding steel gears, none of the gears being in mesh except those that are actually transmitting power. It is claimed that one of these machines will take care of as much work as can be conveniently handled by two men, and that the machine has a production capacity three times as great as a single-spindle machine.



BETTS MULTIPLE-SPINDLE CONTINUOUS VERTICAL MILLING MACHINE

Hercules Key-Seating Machine

The accompanying illustration shows a key-seating machine made by the Hercules Manufacturing Co., Portland, Ore. The machine is simply constructed, the crosshead being driven through a rack and pinion. By means of a wood-covered friction disk operating between the two driving pulleys running in opposite directions and engaging them alternately the reversal of motion is accomplished, it being claimed that the action is very smooth. The length of stroke is adjusted by means of the set-collars at the side of the machine, and the motion of the ram can be started, stopped and reversed by means of the lever at the back.



HERCULES KEY-SEATING MACHINE

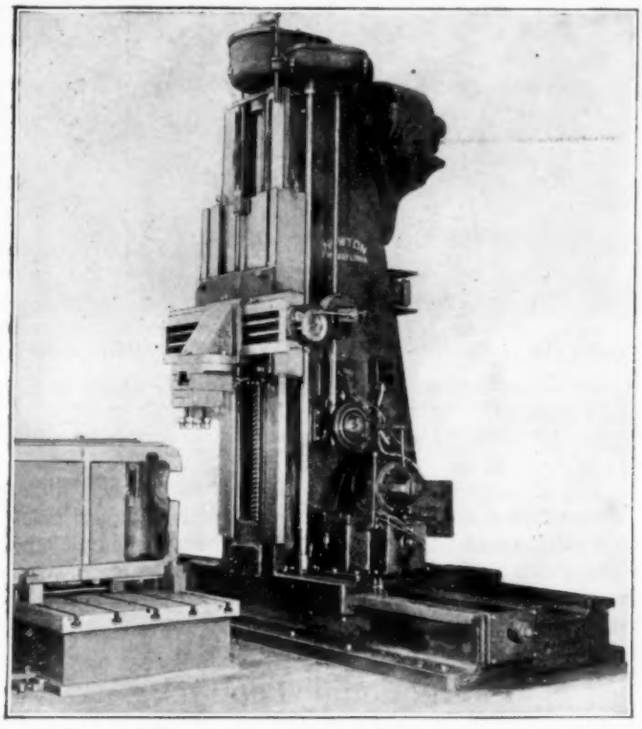
Specifications: Length of stroke, 12½ in. Diameter cutter bar, 2 in. Widest cutter that can be used, 1¼ in. Diameter of faceplate, 20 in. Driving pulley, 12 in. in diameter; speed, 150-250 r.p.m. Strokes per min., 15. Horsepower required, 2. Net weight, 800 lb.

The work is bolted to the faceplate, which can be tilted if it is desired to cut a taper keyway. The machine cuts on the forward stroke, and the cutter is relieved on the backward stroke through the action of two wedge-shaped blocks in the base of the bar rest.

The two knobs on the top of the machine control the feed, one being operated for cutting upward and the other for cutting downward. The rear end of the cutter bar is bored to hold special cutters. Bars of special size can be furnished. The machine is light enough to be moved up to very heavy work, rather than to move the work.

Newton Portable Slotting Machine

The large portable slotting machine shown in the accompanying illustration has recently been brought out by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. The machine consists of an upright mounted on a sub-base and carrying a tool suitably mounted on a saddle that reciprocates vertically.



NEWTON LARGE PORTABLE SLOTTING MACHINE

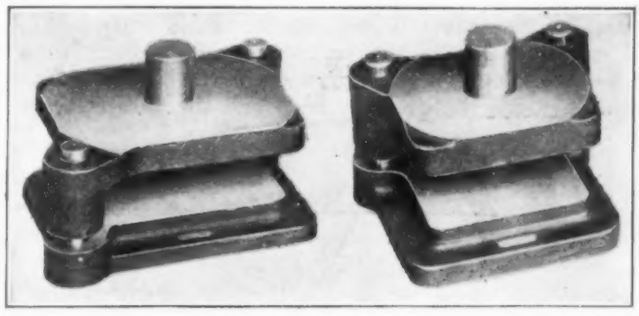
The saddle is counter-balanced and has a maximum stroke of 76 in. The tool slide has a crossfeed of 40 in. and an in-and-out feed of 6 in., both actuated by power. The tool slide has, also, a vertical adjustment on the saddle of 24 inches. The toolholder is hinged, so as to relieve the cutter on the up stroke, and the tool apron can be swiveled through a full circle for angular cutting. The crossfeed of the upright on the sub-base is 84 in., it being driven by a separate 7½-hp. motor that can be engaged by means of friction clutches controlled by a hand lever.

The traverse of the saddle is operated by a coarse-pitch, large-diameter screw running in a one-piece bronze nut.

The screw is driven by a 15-hp. reversing planer-type motor mounted at the top of the upright, the driving gears being fully inclosed. The screw is so fitted with roller thrust bearings at both top and bottom that it acts always in tension. In order to prevent jamming, a clutch is provided which disengages when the saddle reaches the top or bottom of its travel. Dogs for reversing the motion of the saddle are mounted on a rod on the side of the machine.

U. S. Sub-Press

The U. S. Tool Co., Inc., 51-53 Lawrence St., Newark, N. J., manufactures sub-presses of the type shown in the illustration. Special sub-presses are built to suit particular jobs, and stock ones are carried in a range of platen sizes from 2 x 3 in. to 6 x 8 in.



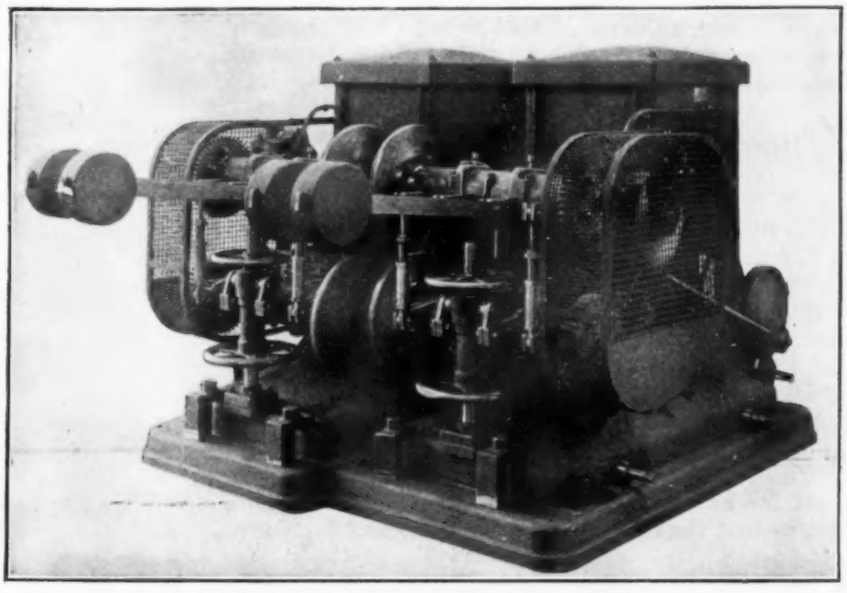
U. S. SUB-PRESSES

Federal Automatic Spot Welder for Channels

The machine shown was made by the Federal Machine and Welder Co., Warren, Ohio, for spot welding two rolled steel channels together to form an I-beam. It is capable of welding two spots at a time on two pieces of material ¼ in. thick, at the rate of 60 welds per min. The two welding transformers are for 220 volts primary, and are air cooled. Four copper disks are used for welding contacts. These are securely bolted to bronze shafts to insure good electrical connections. The secondaries of the welding transformers are connected to the brass bearings of these shafts, completing the welding circuit.

The welding current is controlled by auto transformers in the primary circuit in eight equal steps from 65 per cent to full line voltage.

The welding disks can be adjusted to handle from 4 to 16 in. channels. Simultaneous spot welds from 4 to 12 in. apart may be made. A variable speed motor is used to control the feeding of the work through the machine at from 25 to 60 ft. per min.

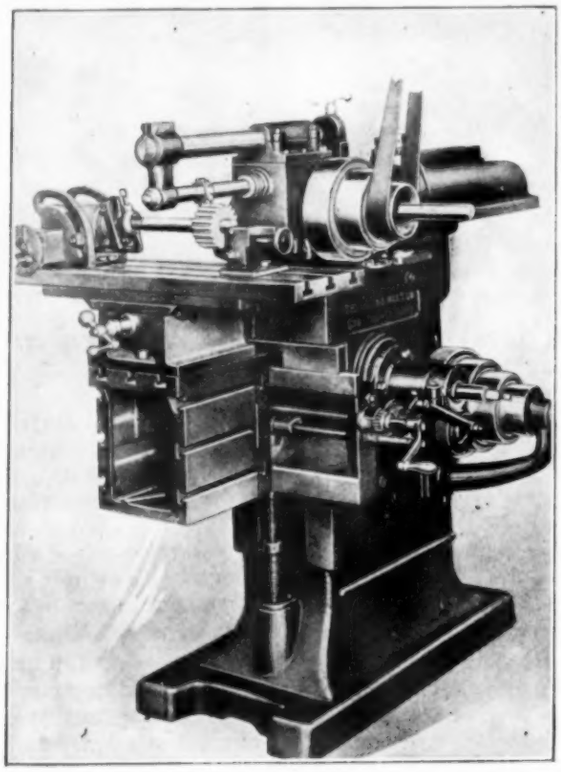


FEDERAL CHANNEL WELDING MACHINE

Tri-State Milling Attachment

The Tri-State Milling Machine Co., Memphis, Tenn., has brought out the milling attachment for shapers shown in the illustration herewith.

The spindle is worm driven and is supported by a substantial overarm. The attachment is intended to be mounted in the shaper ram-way, the ram being moved back out of the way. All parts shown on the shaper, except the dividing head and the tailstock, are



TRI-STATE MILLING ATTACHMENT MOUNTED ON SHAPER

Specifications: Cone pulley steps, 4, 6, 8 and 10 in. Bearings, taper bronze, adjustable. Drive, hardened worm and gear, running in oil. Spindle: hollow, 1¼ in. diameter; hole, No. 4 Morse taper; nose threaded for chuck. Table, 3 ft. long; mounted on swivel base. Cross feed, 7 inches.

part of the regular equipment. Size and make of shaper on which the attachment is to be used should be given when ordering. One arbor is furnished with the attachment.

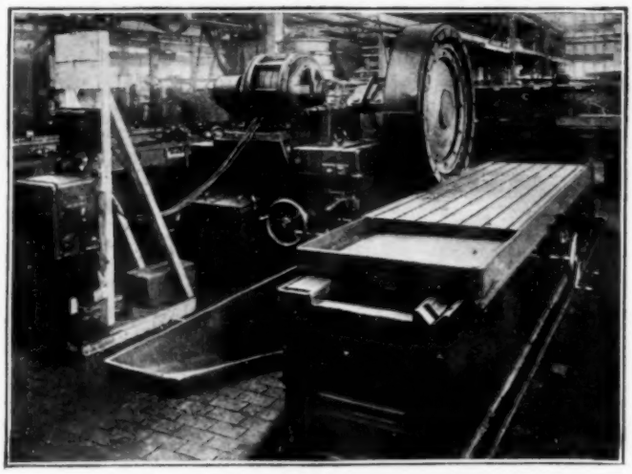
Diamond 54-In. Extra-Heavy-Duty Face-Grinding Machine

The Diamond Machine Co., 9 Codding St., Providence, R. I., has brought out the extra-heavy-duty face-grinding machine shown in the accompanying illustration.

This machine is intended for heavier and larger work than any machines heretofore built of this type and was designed for grinding the bases of multiple-spindle drilling machines.

A sectional-type grinding wheel is used consisting of a number of abrasive blocks held in a chuck.

One of the features of the machine is the provision made for handling the coolant. The tank is of large area so that the necessary volume of coolant is of moderate depth. This arrangement facilitates the settling of sediment so that clean coolant is returned to the circulating system.



DIAMOND 54-IN. EXTRA-HEAVY-DUTY FACE-GRINDING MACHINE

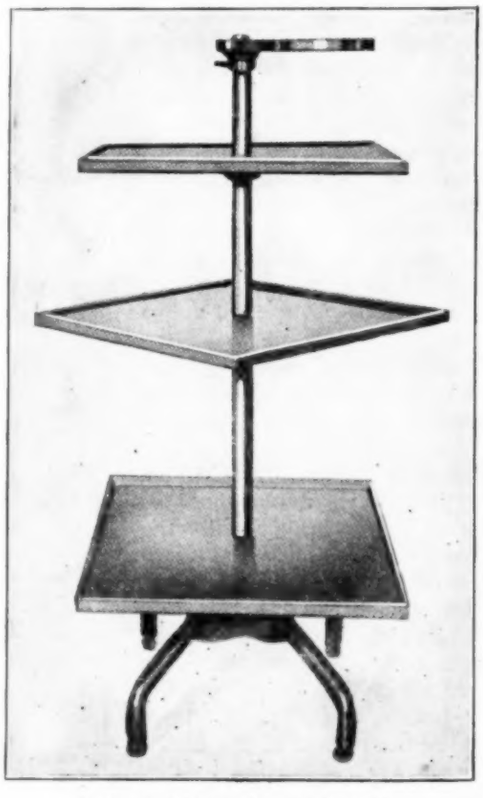
Specifications: Spindle, 9 in. diameter. Grinding wheel, 54 in. diameter. Platen: width, 36 in.; longitudinal travel, 134 in. Speeds of table, 12, 17, 22, 28 ft. per min. Speed of grinding wheel, 324 r.p.m. Feeds, 0.002 to 0.020 in. per stroke of table. Motor, 100 hp. Approximate weight boxed for shipment, including motor, 35,000 lb.

Two sets of centralized controls are provided so that the machine can be operated from either position.

The drive is by a motor mounted on the grinding-wheel head, from which power is delivered to the spindle through a Morse silent chain.

International Toolrack

The International Purchasing Bureau, 203 East 15th St., New York City, has placed on the market a handy toolrack of the type shown. The trays are made of cast iron and are arranged to swivel. The small round tray at the top is intended for micrometers, etc.



INTERNATIONAL TOOLRACK

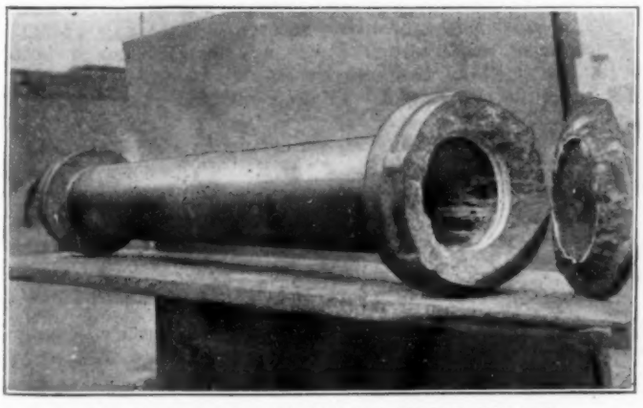
Testing Strength of Oxyacetylene Welded Pipe

At the big gas show at Buffalo, in the course of informal discussion on oxy-acetylene welding of oil pipe lines, a Kansan questioned the strength of the welded line to hold up under the service pressures in his field. What he wanted was a breaking pressure test to determine just where the welded pipe would give way under breaking strains. In his opinion the break would occur in the weld.

The discussion was staged, as it happened, in a stronghold of oxyacetylene welding. One of the factories and machine shops of the Linde Air Products Co. is located in Buffalo and in its Buffalo laboratory the Linde engineers welded together two short sections of standard 3-in. iron pipe, threaded the ends and screwed on two standard cast-iron caps. When the cold water pressure test was applied to the breaking point, the top of one of the caps blew out, leaving the pipe and weld intact. The undamaged cap and the remaining portion of the broken cap were then removed and two extra heavy iron caps were screwed on. At a pressure of 6,200 lb. per sq.in. one of these caps let go, still without injury to the weld or the pipe. Again the uninjured cap and remnant of the broken one were taken off and extra heavy steel caps screwed on. This time the caps held, but the pipe split and ripped under the added pressure upon passing the elastic limit, tearing up to, and being effectually stopped by, the weld which refused to give.

The next test was made with 4-in. pipe. Two lengths were welded together, the ends threaded and two extra heavy standard caps screwed on. In this test one of the cap heads blew out at 4,400 lb., as shown in the illustration, which gave a total end pressure on the cap of approximately 33 tons, proving that the broken cap was not in any respect defective. The weld was not impaired at all. After this test it was suggested that an entirely new weld with other pipe lengths of the same diameter be tried. Accordingly two more lengths of 4-in. pipe were welded, threaded and sealed, this time with extra heavy steel caps made to withstand a working pressure of 3,000 lb. of air. The pressure was applied and the pipe gave way in the threads at 4,200 lb. In all of the tests the welds held securely.

The gentleman from Kansas decided that if there is anything stronger than a good oxyacetylene weld it is not needed in the oil fields of the Southwest. He examined a large number of welded pipe specimens that had been subjected to hydrostatic breaking tests, finding that in no instance had the pipe given way at a weld.



CAP RUPTURED AT 4,400-LB. WELD INTACT

Oxyacetylene welding of oil pipe lines, gas and water mains and laterals is increasing daily in all parts of the country, and it is more and more being specified in preference to riveted and threaded construction.

The Evolution of the Engine Lathe

By Frederick A. Halsey

Referring to Mr. Franzen's very interesting article, "The Evolution of the Engine Lathe," published in your impression for July 22, I think he is in error in his explanation of the origin of the term "engine lathe."

Originally the word "engine" was substantially synonymous with machine. When Watt used the term "steam engine" he meant, and might have said, steam machine. The steam engine was a new thing in the World, being the first power generator apart from waterwheels and the muscles of men and animals. It soon became of commanding importance and the word "engine" thus became identified with it, signifying, as it now usually, but now always, does, a machine for generating power. Before the advent of the steam engine it could not have had this meaning as there was no machine to which to apply it.

The original lathe was a very simple thing, as Mr. Franzen has pointed out and scarcely to be called a machine. When Maudsley added the slide rest and geared headstock it became a machine. It might properly have been called a machine lathe but, as in the case of the steam engine, it was called an "engine lathe" and the term still survives. When the slide rest and back gears are omitted and it becomes less of a machine we drop the word "engine" and call the result a "speed lathe."

This, however, is not the only case in which the word "engine" is still used in the old sense, as we find it applied to machines of high importance or precision. Thus ruling machines of high precision are commonly called "dividing engines" and the machine with which the dentist bores our teeth and tortures our nerves is always called a "dental engine," meaning simply dental machine. I well remember that when Professor Sweet made his first precision grinding machine at Cornell University he called it a "grinding engine."

The most curious survival of all is found in the term cotton gin. Ely Whitney called his machine the cotton engine, meaning cotton machine, but the negroes in their picturesque way, knowing little and caring less about such things, shortened the word engine to "gin." Ultimately the whites adopted the expression and today we hear no other.

The term "engine lathe" is, I believe, now confined in usage to this country. At any rate it is not to be found in English engineering journals except in the advertisements of some American lathes, the copy for which, if not prepared in this country, at best uses the term which we employ for our own product. In England the usual term is slide lathe, sometimes screw cutting lathe.

Regarding the invention of the slide rest, it has always seemed to me that Maudslay did much more than he is usually given credit for. What he really did, in a large way, was to introduce the mechanical control of cutting tools. In this sense he had one anticipation in the boring bar of Wilkinson, but that application was so very special that Maudslay may fairly be credited with the larger conception of the idea.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, July 12, 1920.

BRITISH returns of overseas trading for the half year ending with June last suggest a further considerable improvement as compared with the same period of last year, although the month of June did not make quite such a good showing as did May. For the six months of 1920 the imports have been valued at £1,033,334,684, being an increase of about 44 per cent as compared with the same period of 1919. Exports were valued at £637,466,884, an increase of 90 per cent, and re-exports, valued at £135,891,048, showed an increase of 145 per cent, the total exports thus indicating an increase of about 98 per cent. In the month of June imports were valued at £170,491,230, or £4,157,414 more than for May. Exports were valued at £116,352,350 or £2,967,072 less than in May, and re-exports, valued at £20,123,928, were £136,160 less than May. What is known as the adverse trade balance is now being reduced: it was £260,000,000 for the first six months of this year, this comparing with pre-war figures of about £62,000,000 for the corresponding period of 1913. It is in fact estimated that the "invisible exports" are more than sufficient to make a balance. The satisfactory condition is due to high prices; by some signs a prospective fall, possibly temporary only, in overseas orders for British goods is indicated, and there is at least a suggestion of reduction in prices obtainable.

For persons outside politics and sport, prospects at the moment in Great Britain are rather dull. Retail trades of several kinds continue to show decline in the purchasing efforts of ordinary customers, and the engineering industry as a whole has lost much of its elasticity, owing, apart from other causes, to the further demands of workpeople now under consideration by an Industrial Court. The Restitution of Pre-War Practices Act will expire in the autumn, though it is not very probable that this will lead to much change in the workshops. For the production of some parts of machine tools women were found very serviceable in war time and since then one firm in Halifax fought their battle through all the courts, only to be beaten in the end. This firm specializes in lathe production and was perhaps the first to employ women on the operation of scraping, though other firms soon followed. Machine-tool shops are being carried forward by the momentum of orders received long ago. Very few fresh orders, however, are coming forward at the moment, and a decline in certain small tools is quite as marked. The motor-car industry continues to excite much concern and here, as with engineering concerns, the prices of shares have been falling away steadily. The view is not wanting, however, that this is being engineered to some extent. Banks have been called on to help for the purchase of materials. Prices of cars are held by manufacturers to have reached their upward limit. The ordinary cycle trade has been poor, the season is over, and many machines are reported still in the hands of manufacturers, while the gilt has been taken off the motorcycle industry.

THE IRON AND STEEL TRADE

Firms with sufficient castings are still as rare as houses to let, though if they could depend on foundry promises machinists would not wish for anything better. At the last meeting of the London Iron and Steel Exchange prices remained unaltered, and according to the official report, business continued restricted. The Birmingham report is that new business is being held up, and in Manchester the turn of the tide of prices is predicted. Sheffield denies any slump but admits falling away in special steels owing to the engineering decline. Iron and steel, whatever its quality or stage of manufacture, are still consumed as soon as available. For various well-known and often-stated reasons the export trade is practically at a standstill, and in the circumstances there is not much that is heroic in the further statement that "English and Scotch producers have agreed not to accept foreign orders until the British needs are fully covered." Of construction material more is available; cancellations in the shipbuilding industry are responsible for this. At a recent interview between a deputation from the Federation of British Industries and the chancellor of the exchequer to discuss the excess profits duty and corporation tax, it was stated that orders for seventy-six big ships were canceled last month alone. It is a many-times-told story to add the excess profits duty acts very unfairly to firms with a bad pre-war basis of profits. Firms with a good basis are inclined to remind opponents of the duty that we have had a war and that wars, if paid for, are expensive affairs. At the interview mentioned it was stated that one firm had during the war distributed £120,000 to shareholders and paid by way of tax £800,000. It is useless here to discuss the tax position; the matter will be decided long before these lines can be printed.

As regards supplies, the coal situation is easier. With restriction of exports, the home demand has fallen away, whether for industrial or household coal. Miners threaten once more to strike, on the ground that the prices set by the government are not justified. The strike is intended (1) to lower the price to consumers, (2) to raise wages because of the increased price charged. Meanwhile now one day after giving the order, the Londoner can have delivery of as much coal as he can find room for, at 58s. 2d. a ton.

EMPLOYMENT SITUATION

Although it may not be pronounced, some unemployment is being noted in engineering centers. Discharges are reported, for instance, from Lincoln and from three or four Wolverhampton motor car, etc., firms, one of them having abandoned night-shift working and reducing its force by about six hundred men. Another well-known firm is understood to have reduced its office, etc., staff pretty considerably, but on the other hand to be increasing the number of workpeople. Reductions in commercial vehicle prices have been announced. In the north-west area of England too, including of course Lancashire, the general employment conditions have in part lately been reversed as regards skilled men, for, according to the latest labor exchange report, some 1,061 engineering fitters registered themselves as unemployed, the number of vacancies reported being about forty-three. Similarly, 305 metal machinists were entered as unemployed against 66 vacancies, and 722 boiler makers against 156 vacancies. The case is even worse as applied to semi-skilled and unskilled labor. Here 1,388 engineering laborers registered themselves and twelve vacancies were notified, while as to laborers in shipyards the unemployed numbered 905, with six vacancies. Then 5,844 general laborers (heavy) entered themselves against thirty-six vacancies notified, while general laborers (light) are entered at 1,899, with no vacancies. Turning to the building trades, the conditions are as before: twenty-nine joiners were registered against 781 vacancies, and five bricklayers against 1,132 vacancies. In London, to take a single case of shortage of building labor, seven bricklayers were found engaged on a contract for 400 houses.

In the end the skilled foundry workpeople, like the engineering skilled workers, have declared against any general system of payment by results. As has been reported, this was recommended for acceptance by the workmen's own committee, who pointed out that the minimum district rates proposed would mean a considerable increase in wages, while the schemes gave some measure of management to to the labor side. But in the end the proposal was not officially recommended, and a ballot of the ironfounders, core makers, and metal dressers concerned ended in 11,490 voting against, with 8,216 for acceptance.

Transport systems of more than one kind are in financial difficulties. The most important of course is the case

of the railways. Here for the year 1919-1920 the deficit was £41,349,530. Now the Ministry of Transport issued a statement to the effect that, including Ireland, the working of the British railways will on present workings show a deficiency as from April 1 last of £54,500,000 per annum. A public inquiry is to be held and a rates advisory committee will consider the increases to be made in rates, fares, charges, etc. so as to bring about a balance by the end of June, 1921. It is anticipated that fares, etc., on the average will be increased by about 25 per cent, this bringing in rather more than the sum necessary, provided of course traffic conditions remain constant. We are being reminded that some time ago the present minister of transport suggested in the House of Commons that any increase in goods traffic rates beyond 70 or 80 per cent over pre-war rates was "unthinkable." But the present rates already average about an increase of 50 per cent so that the estimated addition of 25 per cent will mean an increase greater than the limit mentioned by the minister. Of the deficit it has been estimated that more than £22,000,000 will be due to wage increases. The rest of course arises mainly from the higher coal and material costs; that is also largely wages.

The abnormal cost of all the material needed and the inability of manufacturers to give firm quotataions, whether as to price or delivery, plus the difficulty in raising capital in present railway circumstances, are adduced as reasons for the postponement of the electrification of railway lines to the southwest of London.

Then again, the estimated deficiency on the London County Council tramways is £929,512,000 if certain proposals regarding renewals being charged to capital account are accepted, or £1,038,512 if consent is not obtained. The estimated receipts for the year are put at £4,553,930. Salaries and wages which before the war amounted in the year to £1,102,220 are now £3,254,162, and arrears and repairs to rolling stock imply an annual expenditure of £400,000. Fares are again to be revised, but it has been pointed out that although in the past they have already been increased by 100 per cent, in some cases considerably more, in some less, the increase in revenue is but 33 per cent. Then again, the directors of the Underground Electric Railway Co. announce that, after paying full interest on certain 6 per cent debentures but nothing on 6 per cent income bonds, profits of the past half year amount to £42. Similarly the directors of the London General Omnibus Co. state that "the financial position of the company does not justify them in declaring an interim dividend on the shares." The chickens are coming home to roost. But both tram and omnibus workers are preparing to make another demand for higher wages and can fortify themselves by references to increasing costs of food and rents. The decline in wholesale prices has not touched the chief foodstuffs; in fact they have risen. The chief drop is in textiles. The other road transport workers, i.e., drivers of vans, etc., are demanding a fresh national minimum, and a public inquiry is probable.

General Trade News

As to the Machine Tool Exhibition to be held at Olympia, London, W., from September 4 to September 25, one firm has certainly resigned on account of general trade conditions. The space they had taken was immediately let. There have been rumours of other withdrawals, but unsupported, as far as the writer is aware. It is expected that some 200 exhibitors will take part and that 1,000 machine tools will be in motion. Nothing German is to be included. The tools will, in fact, be almost predominently British, that is mainly English, with some American.

Of importance to American and other firms exporting motor cars into Great Britain is the agitation being carried on to prevent cars with left-hand drive entering the country. Consideration of this problem has been one of the first businesses of the new Ministry of Transport. An inquiry has been held and it is confidently predicted that ultimately the entry of such cars will be suppressed. Perhaps next France, having, like the rest of the world, the opposite rule of the road, will object to the entry of right-hand cars as dangerous, and the British motorist will then find difficulty in touring the continent. There is more than a suspicion in the move of another kind of protection.

Seeing that its students are spread all over the world, some readers in America will be specially concerned to learn that Finsbury Technical College has only just escaped, if it has escaped, closure at the end of the next year. Lack of funds is one of the reasons adduced, plus inability to find accommodation for the increasing number of students. The college is of course a plaything of the City and Guilds of London, and rather than lose their independence, the committee concerned have refused offers of financial help from the governement and the Board of Education. The almost lifelong professorship may be mentioned in electrical engineering of the late S. P. Thompson, and in mechanical engineering for many years of John Perry.

New Companies Registered

Company promotion in London during the first six months of this year showed a large increase both in numbers and capital. Apparently some 878 public companies were registered, capital exceeding 290½ million pounds, and 5,537 private firms, capital exceeding 158 millions, the total being 6,415 companies registered, with a total capital of £448,738,317. During the last half of the second quarter the higher capital duty, £1 per £100, had its effect, to say nothing of high bank rates, etc. In engineering the twenty public companies had a combined authorized capital of £4,291,000, and 268 private companies had a capital of £4,388,300. As to motors, twenty-four public companies and 333 private companies were registered, the former with a capital of £8,635,700, and the private companies with a combined authorized capital of £3,953,310.

Resetting a Tool for Boring Tapers

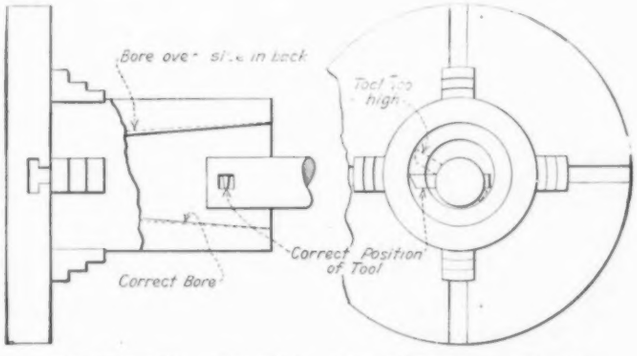
By John J. Burke

Many mechanics, and most of the apprentices, dislike boring tapers for the simple reason that they do not know how. Most of the misfits that occur are due to the improper setting of the tool.

After roughing a hole to nearly the size, the tool is ground for finishing and here is where the harm is done. Instead of setting the tool back in its proper place it is set either too high or too low; the result being that the hole is usually over size in the back. Sometimes the tool is set high or low to begin with and after resetting it is brought nearer the center, making the hole small in the back.

The sketch can easily be understood. It shows the correct position of the tool and one of the many incorrect positions.

In boring a taper it is best to place a short line on the face of the work and let the line just come even with the edge of the tool before removing it for grinding. Then when replacing it be sure that it is even with the line and you will have little trouble in boring tapers.



RE-SETTING THE TOOL FOR BORING A TAPER

Black & Decker Announce No Reduction in Prices for Next Year

The Black & Decker Manufacturing Co. of Baltimore, Md., has issued the following statement to its customers, concerning the possible reduction of prices during the coming year.

"There will be no reduction in prices this year and starting January 1, 1921, we will protect you against loss through price reductions for 60 days after the purchase of goods.

"We have recently had a number of inquiries from jobbers asking if any reduction in price was contemplated in the near future. This has suggested to us, in line with our policy of co-operation with our jobbers, that we can work more closely with them in this respect.

"There is no price reduction of any kind possible on our line at present and you may accept this letter as guaranteeing you against any decline in the prices of Black & Decker portable electric drills, electric valve grinders or electric air compressors, between now and December 31, 1920.

"Furthermore, we take this opportunity of advising you that after that time you will be protected against loss through price reduction for a period of 60 days after purchase of our products. This does not mean if conditions make it possible for us to get a lower price on our products that we will give you 60 days notice and defer the reduction for that length of time. If a reduction is possible it will be made promptly so as to give the ultimate purchaser the benefit and we will absorb any loss which would otherwise be caused the jobber who bought within 60 days before the change in price."

R. T. Hazelton Now Works Manager of Cincinnati Shaper Co.

R. T. Hazleton, who was superintendent and chief engineer of the Cincinnati Milling Machine Co. for several years, is now works manager of the Cincinnati Shaper Co., Cincinnati, Ohio. Mr. Hazleton undertook his new duties July 1, coincident with the throwing into operation of the large addition to the plant of the company just completed.

Mr. Hazleton in his new position will also have charge of production for the Cincinnati Gear Cutting Machine Co., which is a subsidiary of the Cincinnati Shaper Co. Following the program of expansion of these companies, and the large additional floor space now available, it is anticipated that the output of the two companies will be doubled in the very near future.

Belgian Import Duty Increased

A bit of news that may be of interest to the trade is that the Belgian customs duties have been increased on many articles. This, following French precedent, is accomplished by the promulgation of a royal decree directing the ministry of finance to levy customs duties at so many times the established tariff, the rate of increase varying according to the class of article. On machine tools the figure is three, which means that, until modified, duties will hereafter be 60 frs. per metric ton (net weight) instead of 20 frs. per ton as heretofore. This is still not a very heavy burden, but it is interesting to note that the rate on machine tools is increased by the highest co-efficient listed, three being applied only to certain articles which are largely manufactured in Belgium. One wonders if the Belgians think that they are manufacturing machine tools also.

A Professor of Mechanical Engineering Writes on the Metric System

There is, I believe, a mistaken feeling that college officials and professors can be expected to favor the metric system and urge its adoption in this country to the exclusion of our established system of weights and measures. Such a feeling may exist among those who have not had practical manufacturing experience but on the part of professors of mechanical engineering and those who are familiar with the needs of our factories I believe there is a strong sentiment against a change. Further, I feel that it is distinctly hurtful to instill into the minds of college students ideas favoring a change in our basic standards which later experience in practical work makes it necessary to revise.

Colleges and universities should make every effort to co-operate with manufacturers instead of promulgating radical ideas which will "throw a monkey-wrench into the wheels of industry."

L. P. BRECKENRIDGE,
Professor Mechnical Engineering, Yale University.

Navy Lists Excess Bolts, Nuts, Rivets and Washers

The Navy Sales Board in Washington announces that a consolidation of lists of steel and iron bolts, nuts, rivets and washers into a new catalog is being made. These articles are now being held in large quantities at the various Navy Yards and are to be sold by sealed bids. This catalog will include all classes of bolts, with and without nuts, hexagonal and square head, black and galvanized. It will include all styles such as standard, carriage, stove, eye, forcing, stud, etc. Separate nuts will be round and hexagonal, blank and galvanized, and standard and case hardened. Rivets are ship, boiler and structure. Washers will be both iron and steel.

It is suggested that all prospective purchasers of these articles send their names in at the earliest possible moment to the Board of Survey, Appraisal and Sale, Navy Yard, Washington, D. C. This will insure their receiving a catalog as soon as it is ready for distribution.

A new steel catalog is also under consideration which will contain approximately 20,000 tons of plates, sheets, structural shapes, bars and billets.

Levey and Associates Organize Film Co.

Harry Levey, for three years manager of the industrial and educational department of the Universal Film Co., has resigned that position to head a producing company of his own, which will exclusively make this type of picture. Connected with the organization are Don Carlos Ellis, formerly head of the film service of the Department of Agriculture, and Mrs. Henry Moskowitz, secretary of the New York State Reconstruction Commission and the Governor's Labor Board.

Mr. Levey has already started motion picture production on a fairly large scale. He has been retained by the Association of Chemical Industries to make a series of pictures showing the history of dyes, explosives, medicines, automobiles, aeroplanes, paint, leather, electrical supplies and food preservations.

The Jersey City Chamber of Commerce recently asked its members to indicate their views regarding the "open shop." The result was 827 to 0 in favor of the "open" and against the "closed" shop. Of the 116 manufacturing plants at present operating in Jersey City, 96 are open and 20 are closed.

LD'S INDUSTRIAL FORGE
News Editor

German Machine Industry Faces Dangerous Crisis

According to the press, a report from the Union of German Machine Plants shows that during the year ended June 1, 1920, this industry suffered enormously from labor troubles and shortage of materials. A marked shortage of skilled labor was also felt. The attitude and conduct of the older workmen was satisfactory, but much trouble was experienced with the younger workmen, who were opposed to doing piecework and objected to overtime. The union estimated that in the year just closed that labor was only 50 to 60 per cent efficient. In spite of signed agreements the workmen made demands from month to month for increased wages. Auxiliary materials like leather and oil were difficult to obtain, and oil which formerly cost only 40 marks per 100 kilos is now sold at 1,700 marks per 100 kilos. The uniting of different plants and the standardizing of types of machines showed encouraging progress. The rise in the value of the mark has caused a falling off in orders and has increased the stagnation of business. To keep plants running even at part time many of them took to doing repair work.

Practically all orders from Poland and Austria have ceased because of unfavorable exchange. The high cost of production has also necessitated large capital increases. The prospect of normal business for the coming year is most doubtful because of the uncertainty as to future supplies of raw material, coal, electric current, and transportation. If conditions do not soon improve, it is anticipated that many factories will have to close down. Competition in foreign countries is difficult to meet, and on the whole the future of this industry is not at all encouraging.

Large Force Needed to Make Our Cutlery

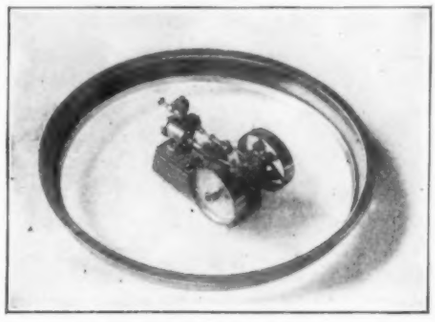
The cutlery industry continues very strong, according to the Cutlery Bureau of Information, New York, and is adding new men every month to its force of helpers.

Statistics for the State of New York, which are representative of the situation all over the United States, prove that the ratio of employment in the industry shows a new gain and that now 174 men are employed for every 100 which found employment during June, 1914. The total wage payments of the industry have more than trebled as compared with the time before the war.

A Small Model Steam Engine

The small model steam engine shown herewith is not new, having been exhibited at the world's fair nearly 30 years ago; but when our correspondent ran across it a few weeks ago he decided that it was worth photographing and presenting as a novelty to our many readers, to whom the world's fair is very ancient history indeed.

The thing upon which the model is resting in the engraving is not a pie-plate; it is the crystal and bezel ring of an ordinary-sized watch. The engine is made of gold, silver, brass and steel, and weighs 20 grains. The bed is $\frac{1}{4}$ in. long; the bore of the cylinder



MODEL RESTING ON WATCH CRYSTAL

is 0.083 in., the stroke $\frac{3}{32}$ in. It has a perfect working flywheel governor, a cylinder lubricator and a throttle valve. There are stuffing boxes around valve and piston-rod that can be packed and the main bearings are adjustable for wear.

The model was built by Charles H. Allen of Pittsburgh when he was but 19 years old. The construction occupied his spare time for 15 weeks.

G. M. Graham Elected Vice-President of Pierce-Arrow Co.

The Pierce-Arrow Motor Car Company announces the election of George M. Graham as vice president, succeeding W. J. Foss, who resigned on July 1.

Mr. Graham went to the Pierce-Arrow Motor Car Co. from the Willys-Overland Co., and during his four years at Buffalo has successively held the place of assistant commercial manager, general sales manager and now vice-president.

During the war Mr. Graham was chairman of the National Motor Truck Committee at Washington, representing the entire motor-truck industry in all of its activities that centered there. He has been spokesman for the motor-vehicle industry in many important presentations.

Work of Engineering Council's Committee Classification and Compensation Endorsed

Lars R. Jorgensen, electrical and hydraulic engineer of San Francisco, Cal., who has been appointed on a committee of the American Society of Civil Engineers to consider the recent request for endorsement of its work by the Committee on Classification and Compensation of Engineers of Engineering Council, writes as follows:

"About six months ago I was a member of a committee appointed by the Civil Service Commission of California to work out classification and compensation for engineers in Civil Service in the State of California. In this particular case it was the electrical engineers only.

"After much investigation, inquiry and work, we found that we could not propose anything better than the classifications recommended by the Engineering Council. We had advance copies of same at the time.

"In my opinion there is no doubt that this classification, dated Dec. 15, 1919, is the best obtainable and can be used everywhere in the United States to great advantage. It is most complete, very well worked out as to details, and such a uniform classification ought to be adopted all over the country. I know it represents a great deal of work to compile such a document, and we should be grateful to the men who did all this work. My vote will be for the adoption of this classification.

"When it comes to compensation of engineers in the various grades it is more difficult to lay down a standard rule to be followed in all parts of the country, but the proposed rates of compensation seem to be elastic enough to allow for necessary local variations, and to constitute a good guide, which is really all that can be expected.

"I believe it will be of great advantage to the engineering profession if Engineering Council's Classification and Compensation of Engineers are generally adopted."

French Machine-Tool Purchases

The French mission acting on the machine-tool contract with the United States returned to France from America a short time ago, having selected and shipped some 1,100 machines in all. Since the kind of machines the mission particularly wanted could not be found in the War Department's stocks its members consider the contract terminated. The machines they would have purchased were: bor-

ing mills, horizontal boring machines, gear-cutters, car-wheel lathes, heavy planers, forging machinery, bolt and nut machinery, large punches and shears, etc. They still have on hand in their warehouses in France more of the standard sizes of the usual machine-shop tools than they require.

The approval of the contract by the French Chamber of Deputies did not carry with it the authority to purchase the machines elsewhere, consequently the Ministry has no funds or credit for the purpose. As a matter of fact, a responsible French official stated that the policy of the present government is to restrict, as far as possible, purchases for governmental account; and that therefore they did not anticipate going into the market and buying machine tools for stock. The government officials feel that it is up to the manufacturer to purchase direct such special machinery as he may require.

There is no confirmation from the War Department of the United States regarding the number of machines the mission finally bought, nor regarding the termination of the contract, but the French view given above is, no doubt, correct.

Davenport Dons Denim—Does Daily Drudge

Picture the once immaculate figure of a real, honest-to-God state senator, clad in the uniform of a twentieth-century machinist (even the white collar and shell-rim glasses)—and you have an idea of Frederick M. Davenport, senator from the Thirty-sixth (Oneida) district, of the State of New York, spending his vacation in the plant of the Franklin Automobile Co. at Syracuse, N. Y.

At the invitation of Mr. Franklin the erstwhile legislator took up this new phase of life in order to get some first-hand "dope" on present industrial relations as affecting factory employees.

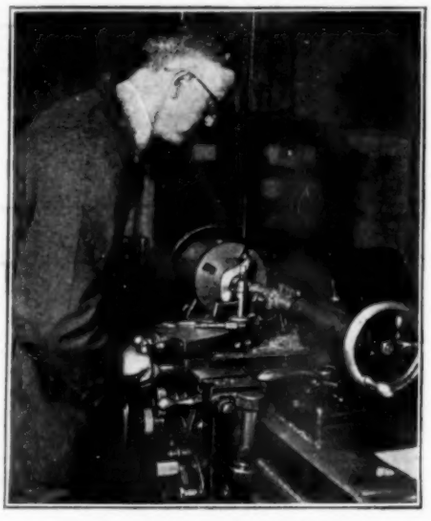
Senator Davenport doesn't punch a time clock but he's as punctual as any man in the plant, commuting every day from home and "getting the inside," the real point of view of the mechanic and laborer by working alongside him in daily association.

The senator has learned a lot about industrial operation since he came here a month ago and expects to learn a lot more before he quits to take up his regular job of teaching law. He is particularly impressed with the training in infinite detail the man who produces in an automobile plant is obliged to undergo.

"I have driven an automobile for 10 years with scarcely a thought of the processes through which it went and the mental and physical keenness required in its construction. I scarcely ever even looked under the hood," said the senator. "But my work here has taught me the vast importance of the various operations. I received a letter from Mr. Franklin indicating, in substance, that he had been keeping his eye on my interest at Albany in the direction of measures to establish better industrial relations between employer and employee and suggesting that it might be mutually helpful if I had an opportunity to spend some time inside a great industrial unit like the Franklin plant.

"Upon conferring with Mr. Franklin I found that we agreed that the matter of sounder industrial relations between employer and employee is of vital importance to the future of the country, and that whatever is done ought to be done with care and kept close to the actual facts and needs of industry."

Senator Davenport says he has had great freedom of movement and of information, having studied the policies of the management on the one hand and working at the lathe among the men on the other hand. This week he is going into the toolroom and will probably put in some time among the final test men, the fellows who really have the last word before a car is sent out of the factory.



SENATOR DAVENPORT

New Pierce-Arrow Dual-Valve Trucks Mark Big Advance

Announcement of an expanded line of motor trucks, powered by dual-valve engines, is made by the Pierce-Arrow Motor Co., of Buffalo, N. Y. The new line includes five-ton, three and one-half-ton and two-ton trucks and a tractor unit, each equipped with double ignition and electric lights.

The dual-valve power plants which distinguish the advanced design are declared to effect as great a forward stride in motor truck performance as did the introduction of the worm gear, pioneered by Pierce-Arrow in 1910.

"The dual-valve engines equip the trucks with a pulling power superior to any demand," said Robert O. Patten, truck sales manager of the company. "Moreover, this power is obtained with an increase in economy; gasoline yields more miles per gallon."

The dual-valved engine, constructed on the principle of the dual-valve engine developed by Pierce-Arrow engineers so successfully in passenger-car use, has been in process of design and test for more than two years. Extended usage under actual working conditions has eliminated all guess work as to what its performance is.

Adherence to the basic Pierce-Arrow engineering principles, the company states, insures that the present line retains the distinctive characteristics of reliability and durability. But with the refinement of design, the new trucks not only set new performance standards, but establish a record low level of repair and maintenance costs. This is achieved through an accessibility which permits of quick, economical repairs, insuring a minimum of time lost in the service shop and a minimum of repair costs, according to the company's statement.

Modernized manufacturing methods combined with an expansion of factory facilities necessitated by efficient war production methods has enabled the Pierce-Arrow company to enhance the quality upon which Pierce-Arrow reputation has been built. More accurate machining, an even greater uniformity of product and improved methods of testing have achieved the result.

Details as to the specifications of the new models and facts as to their actual performance may be obtained from the company or any of its distributors in all of the principal cities of the country.

The technical department of the University of California, Extension Division, announces a new course by correspondence in Determinative Mineralogy and Blowpipe Analysis, by Arthur S. Eakle, Professor of Mineralogy in the University of California. It is equivalent to the course given in the regular session of the University. Two units of University credit will be given, if desired, on the passage of an examination. For further information write to the University of California, Berkeley, Cal.

Business Items

The Phoenix Manufacturing Co., Eau Claire, Wis., has announced the removal of its office from Cleveland, Ohio, to Chicago, Ill. W. L. Harrison, who has been manager of the Cleveland office for a number of years, will manage the Chicago office.

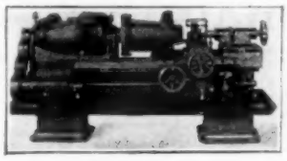
The Hart-Parr Co., Charles City, Iowa, on account of the rapid expansion of its overseas trade, has appointed E. R. Verhaeghe, of Anvers, France, to act permanently in supervisory capacity over the European territory. He has been in charge of the tractor department of the Hart-Parr distributors in Anvers, France, ever since the Hart-Parr tractors have been sold there. He

(Continued on page 340b)

Condensed-Clipping Index of Equipment

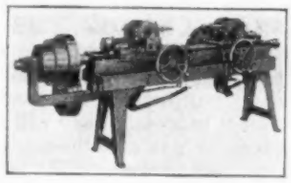
Patented Aug. 20, 1918

Lathe, Crankshaft, Line-Bearing and Flange Turning
Wickes Brothers, Saginaw, Mich.
"American Machinist," July 15, 1920



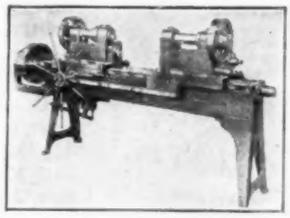
The lathe is used for turning the line-bearings and flanges of crankshafts and is made in one size only with a 20-in. swing. The headstock is back geared to suit the job and the drive is either by belt from countershaft or direct motor as required. The spindle has a collar on the work end, forged integrally, and all bearings are ground to size. A Hilliard multiple-disk clutch transmits the power. The gear box has eight feeds. A cast-steel pot chuck is furnished, designed especially for the crankshaft it is to support.

Drilling Machine, No. 7 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



The machine is used for opposed drilling and reaming and has a power feed. The design permits the drilling and reaming spindles to be run at different speeds. The drive is from the three-step cone-pulley at the left through a central driving shaft, and from this through suitable gearing in the carriages or sliding heads. The gears can be changed so as to run the spindles on one carriage faster than those on the other, if desired, and the spindles are adjustable for position. Specifications: Length of bed, 7 ft. Width of bed, 10 in. Distance between spindle ends; minimum, 4 in.; maximum, 30 in. Hole in spindles, No. 4 Morse taper. Distance from spindle to bed, 8 in. Capacity; up to 1¼-in. drill. Each carriage has three feeds.

Drilling Machine, No. 8 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



The machine has special spindle heads designed to meet the requirements and is similar in its general character and construction to the No. 7 duplex machine, with the exception that it is not equipped with power feed. The feed is actuated by the pilot wheel at the left through a pinion and two opposed racks, thus feeding the two spindle heads equally. An adjustable stop is located on the left-hand head, which permits regulation of travel in order to provide for drilling the holes to the proper depth and to prevent the two drills from coming in contact. The gears can be changed to drive one spindle faster than the other, if so desired. Specifications: Length of bed, 7 ft. 8 in. Width of bed, 12 in. Distance between spindles, minimum, 10 in.; maximum, 40 in. Hole in spindles, No. 4 or 5 Morse taper. Distance from spindle to bed, 8 in. Capacity, up to 1⅝-in. drill.

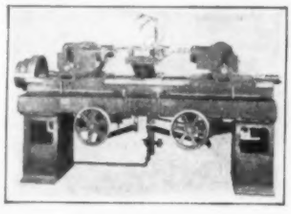
Drilling Machine, No. 9 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920

The two opposed spindles in front perform the drilling operation, and the two rear spindles the reaming. The machine is driven by two belts from the countershaft, one to each spindle head. It employs hand feed by rack and pinion, but power feed can be furnished if desired. The hand-feed machine is equipped with a ratchet lever and the power-feed machine with a handwheel. Specifications: Dimensions of table, 7 x 9 in. Height of table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 16 in. Travel of each head, 5 in. Hole in spindles, No. 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,000 lb.

Drilling Machine, No. 10 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920

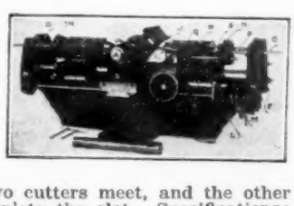
The machine is similar to the No. 9 machine, except for the feed of the heads. The heads are geared to travel in the same direction, which arrangement is employed when one head is used for drilling and the opposed head for reaming. Since special heads can be built to drill any number of holes at the same time, this feature is a desirable one, because it permits of drilling and reaming at a single setting of the work in the jig. Specifications: Dimensions of table, 7 x 12 in. Height of the table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 18 in. Travel of head, 6 in. Hole in spindles, No. 2 or 3 Morse taper. Capacity, four ¼-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,200 lb.

Drilling Machine, No. 12 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



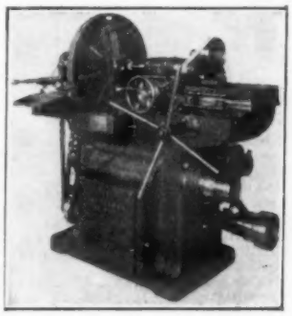
The machine is provided with power feed, which can be automatically disengaged at any desired point. The drive is effected from a shaft extending along the back of the bed. This shaft is splined throughout its length and is driven by a three-step cone pulley. Specifications: Distance between spindle ends; minimum, 8 in.; maximum, 44 in. Capacity, eight 1¼ in. drills in cast iron. Height of bed from floor, 40 in. Maximum center distance between end spindles on same carriage, 24 in. Floor space, 4 x 8 ft. Net weight, 5,000 lb.

Milling Machine, No. 3 Duplex Slot
Garvin Machine Co., Spring and Varick Sts., New York.
"American Machinist," July 29, 1920



The machine is capable of slotting the largest locomotive crossheads, and it is adapted to other work such as cutting keyways and slotting fork ends. The machine mills both sides of a slot simultaneously, the work reciprocating and the cutters feeding inward intermittently. When milling slots entirely through a piece, one cutter automatically retreates before the two cutters meet, and the other one continues to advance and complete the slot. Specifications: Size of cutters used, ¾ to 2½ in. Table, size, 21 x 87 in.; maximum travel, 10 in. Swing; over table, 30 in.; over bed, 12 in. Spindles; taper hole, No. 11 B. & S.; maximum distance between, 41 in. Spindle sleeves; diameter, 6 in.; length of bearing, 24 in. Feed; total per spindle, 6 in.; per table stroke, 0.01 to 0.025 in. Motors; speed, 650 to 1,950 r.p.m.; horsepower, 5. Length of bed, 128 in. Floor space, 100 x 190 in.

Grinding Machine, No. 9 Hole
Van Norman Machine Tool Co., Springfield, Mass.
"American Machinist," July 29, 1920



The drive is self-contained and is mounted on the machine base. The machine can be furnished with motor drive, in which case the motor is placed inside the cabinet base. All driving shafts are mounted in self-aligning ball bearings. The work head is mounted on a transverse slide, providing ample room for the operator to gage the work and to handle it in or out of the machine without danger of injury to his hands. Specifications: Swing, 20 in. Will grind holes 4½ in. deep. Speeds; work spindles, six, from 72 to 431 r.p.m.; grinding spindle, three, from 3,400 to 19,000 r.p.m. Floor space, 39 x 63 in. Weight; net, 2,950 lb.; boxed, 3,100 lb.

Clip, paste on 3 x 5-in. cards and file as desired

will now co-operate with the dealers in England, Belgium, Denmark, France, Sweden, Spain, Portugal, Algeria, Tunis and Egypt. The next month will be spent by Mr. Verhaeghe at Bruges, Belgium, in the interests of the Hart-Parr.

The Wellman-Seaver-Morgan Co., Cleveland, has taken a contract for two 200-ton tilting furnaces for the Imperial Steel Works, Japan. These furnaces will be used in connection with a Talbot process. They will be fired with producer gas and their tilting mechanism and valves will be electrically operated.

The Hercules Electric Co., Indianapolis, Ind., plans the installation of such new machinery as will enable the company to manufacture magnetos, electrical machines and devices. Additions on a large scale are planned at the plant, which recently was purchased by Charles G. McCutcheon, Indianapolis, and Perry and Frank Remy, former owners of Remy Electric Co. at Anderson, Ind.

Personals

JOHN GREGG, attorney for the Hart-Parr Co., Charles City, Iowa, returned recently from a six months' trip through twenty-two countries of Europe on business connected with the Hart-Parr tractors. The Hart-Parr Co. will give a banquet in Mr. Gregg's honor.

CARL HOLL, formerly connected with the Persons Manufacturing Co., Worcester, Mass., is now with the Graton & Knight Manufacturing Co., Worcester, makers of factory leather belting.

JOHN P. GREGG, of the Hart-Parr Co., Charles City, Iowa, has been promoted to divisional sales manager for the Canadian territory and will have charge of all sales of northwestern Canada.

Obituary

AMOS WHITNEY, founder of the Pratt & Whitney Co., Hartford, Conn., and for a number of years president of the Gray Pay Station Telephone Co., died on Aug. 5 at Poland Springs, Me. He was eighty-seven years old. [Mr. Whitney's biography will be published in our next issue.]

FRANK TAYLOR, former president and one of the founders of the Taylor Instrument Companies, died recently at his home at 47 Wellington Avenue, Rochester, N. Y., in his 76th year.

CLARENCE A. SEVERIN, Cleveland manager of the Reed-Prentice, Becker Milling Machine and the Whitcomb-Blaisdell Machine Tool Co., died on Wednesday, July 21.

Trade Catalogs

Grinding Wheels. Norton Co., Worcester, Mass. A small circular illustrating and describing the balancing of grinding wheels for Norton precision grinding machines.

Precision Levels for Machinists. Queen-Gray Co., Philadelphia, Pa. Bulletin A-5, pp. 7, 8 x 11 in. An illustrated and descriptive bulletin of precision levels for machinists.

High Precision Measuring Tools. The Golden Co., 405 Lexington Ave., New York City. Catalog No. 257, pp. 3, 8½ x 11¾ in. This catalog briefly describes and illustrates the various machines and appliances made by the Societe Genevoise d'Instruments de Physique, for whom this company is the exclusive agent.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES, DURING MAY, 1920
METAL-WORKING MACHINERY

Countries	Lathes 491	Other Machine Tools 492	Sharpening and Grinding Machines 493	All Other 495
Belgium	$29,148	$67,689	$14,732	$96,452
Czechoslovakia	.....	.....	1,678	.....
Denmark	5,147	7,914	9,317	.....
Finland	.....	1,998	.....	.....
France	75,499	230,167	68,917	234,423
Germany	.....	6,890	790	6,542
Greece	725	3,942	.....	1,412
Iceland and Faroe Islands	.....	.....	52	.....
Italy	24,685	107,397	8,604	168,470
Netherlands	5,702	1,875	1,230	2,243
Norway	.....	2,466	860	9,823
Poland and Danzig	.....	.....	1,500	.....
Portugal	3,403	3,190	37	.....
Roumania	4,733	2,348	825	8,015
Spain	59,940	18,807	4,158	30,279
Sweden	13,941	15,028	10,682	3,647
Switzerland	198	13,456	.....	11,002
Turkey in Europe	.....	651	.....	.....
England	246,812	445,605	67,202	574,513
Scotland	.....	10,613	444	3,640
Ireland	.....	2,803	733	13,976
Bermuda	.....	314	250	.....
Canada	90,665	140,893	26,943	207,941
Costa Rica	.....	3,251	444	.....
Guatemala	.....	116	.....	.....
Honduras	.....	638	.....	.....
Nicaragua	.....	484	.....	.....
Panama	300	174	15	6,175
Salvador	.....	.....	22	.....
Mexico	18,179	7,665	3,339	15,863
Miquelon, Langley, etc	1,050	.....	.....	.....
Newfoundland and Labrador	2,550	.....	.....	170
Barbados	.....	7	.....	.....
Jamaica	56	.....	105	.....
Trinidad and Tobago	112	378	.....	.....
Other British West Indies	106	45	.....	.....
Cuba	24,656	24,068	3,519	24,497
Dutch West Indies	.....	100	.....	.....
French West Indies	.....	85	.....	.....
Haiti	.....	.....	307	.....
Dominican Republic	2,250	281	360	1,454
Argentina	13,140	8,848	706	15,161
Bolivia	650	171	500	1,440
Brazil	12,763	20,473	1,924	3,115
Chile	519	3,377	172	1,171
Colombia	4,631	7,590	228	2,213
Ecuador	935	51	.....	.....
British Guiana	.....	312	.....	.....
Paraguay	.....	358	.....	.....
Peru	6,027	7,019	2,592	5,838
Uruguay	1,700	1,098	26	.....
Venezuela	2,324	606	330	466
China	27,052	6,202	2,700	35,722
Kwantung	.....	.....	1,255	4,000
British India	46,106	23,386	1,237	104,788
Straits Settlements	.....	490	103	2,104
Other British East Indies	.....	.....	22	.....
Dutch East Indies	2,241	1,159	4,657	4,279
Hongkong	.....	572	595	.....
Japan	61,518	66,182	15,690	271,640
Turkey in Asia	3,300	150	.....	.....
Australia	5,517	30,217	10,658	10,896
New Zealand	6,212	3,924	1,036	1,093
French Oceania	.....	.....	.....	965
Philippine Islands	9,522	2,955	1,565	21,104
Belgian Kongo	4,944	.....	.....	.....
British West Africa	30	.....	.....	.....
British South Africa	5,159	11,086	1,818	9,451
British East Africa	.....	566	.....	.....
French Africa	787	.....	.....	.....
Portuguese Africa	3,650	348	108	1,867
Egypt	850	.....	1,050	1,571
Total	$829,434	$1,318,478	$276,057	$1,919,421

Condensed-Clipping Index of Equipment

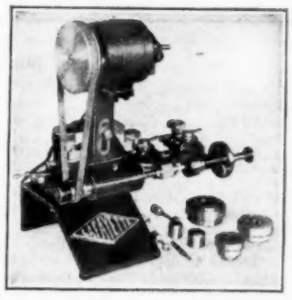
Patented Aug. 20, 1918

Grinding Attachment, Button Die

Lafayette Tool and Equipment Co., 21 South 12th Street, Philadelphia, Pa.

"American Machinist," July 22, 1920

The attachment comprises an index plate, a set of nine die holders, a graduated adjustable feeding device for the rack work holder, chucks and abrasive pencils. The die holders will accommodate A. S. M. E. standard and fractional dies, and the index plate is drilled for both three- and four-grooved dies. The work, while held rigidly in the die holder, is controlled by the index plate which can be set to suit the various widths of flutes in the dies to be ground.

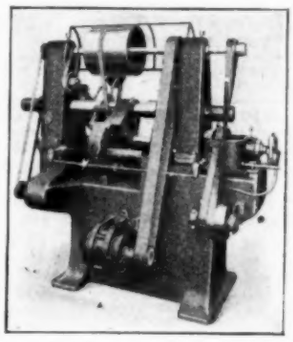


Grinding Machine, No. 15, Bryant Chucking

Bryant Chucking Grinder Co., Springfield, Vt.

"American Machinist," July 29, 1920

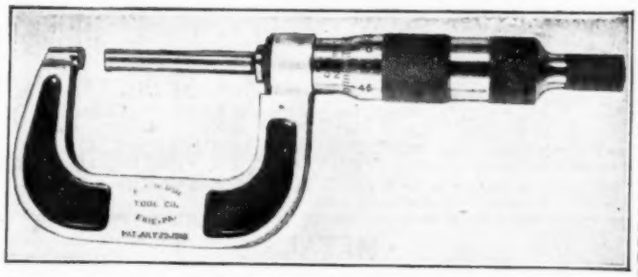
The machine is self-contained, and is furnished in two types—a single-spindle machine for grinding holes only and a double-spindle machine for both hole- and face-grinding. The illustration shows a rear view of the No. 15 single-spindle machine with motor attached. Two speeds are provided for the work spindle and two traverse speeds for the wheel slide. The wheel-spindle drive shafts are mounted in ball bearings of inclosed type. Specifications: Chuck range, 12 in. Grinding length, 9 in. Work spindle, 150 and 300 r.p.m. Wheel-slide travel per revolution of work, $\frac{1}{16}$ and $\frac{1}{8}$ in. Weight, net, 3,000 lb. Floor space, 36 x 84 in. Motor recommended, 2 hp. 1,720 r.p.m.



Micrometer, Blush Multiple

A. T. Blush Tool Co., 1145 West 11th St., Erie, Pa.

"American Machinist," July 29, 1920



The micrometer illustrated herewith can be used to measure from 0 to 2 in. without any attachment. The spindle has a screw of 20 threads per in., while a separate screw of 40 threads per in. is used for traversing the thimble.

Torch, Pumpless Blow

Pumpless Blow Torch Co., Phipps Power Bldg., Pittsburgh, Pa.

"American Machinist," July 29, 1920

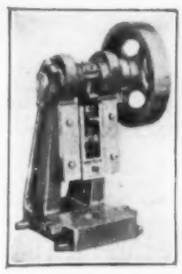
The torch does not require preliminary pumping and pre-heating. The fuel used is butane, obtained from natural gas and reduced by pressure to a liquid. Two ducts lead from the fuel chamber to the burner; one from the top and one from the bottom. To start the torch, the valve in the upper duct is opened, allowing the gas to flow directly to the burner where, upon ignition, it burns with a clear steady blue flame at a temperature of 2,240 deg. F. After burning for a minute or two the burner becomes hot, the valve in the lower duct is then opened and the upper one closed, allowing the liquid fuel to flow to the burner where it is volatized by the heat.

Press, Verson No. 00 Power Bench

La Salle Machine Works, 3013 La Salle St., Chicago, Ill.

"American Machinist," July 29, 1920

This machine is adapted for blanking, forming and other press operations and can handle such light work as is often done on a larger machine. The clutch is made of tool steel and hardened. It is simple in construction and of the positive type. It is provided with an automatic safety device which disengages the clutch at each revolution of the press whether or not the treadle is released. The machine is of the open-back type, and permits feeding the work either from right to left or from front to back. The press can be furnished with a table and legs if desired. Specifications: Stroke of slide, $\frac{3}{4}$ in. Adjustment of slide 1 in. Width of opening through back, $3\frac{1}{2}$ in. Finished surface of bed, 7 x $5\frac{3}{4}$ in. Diameter of hole in bed, $1\frac{3}{4}$ in. Diameter of shaft, 2 in. Flywheel, 10 in. diameter; face, 2 in.; speed, 250 r.p.m.

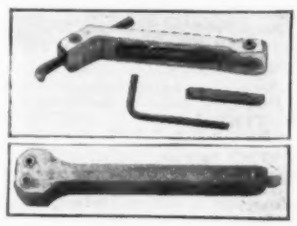


Toolholders, Rouillard Universal

Rouillard Tool Corp., 608 Chestnut St., Philadelphia, Pa.

"American Machinist," July 29, 1920

The holes for the cutters in both holders besides being reamed are partially squared with a broach so that they will hold square, round or octagon stock equally well. The set-screws are of the hollow-head type with fine pitch S. A. E. threads, but square-headed screws can be used if preferred. In addition to the regular line of cutters for turning and boring, special attachments such as knurling and gooseneck turning and threading tools, are furnished when required. The toolholders are drop-forged and pack-hardened and are made in seven sizes; the smallest, No. 0, is $\frac{3}{8}$ x $\frac{3}{4}$ x $4\frac{1}{2}$ in.; the largest, No. 6, is 1 x $1\frac{3}{4}$ x 13 in.



Burner, The Berg

Berg Burner Co., Inc., 100 Emerson Place, Brooklyn, N. Y.

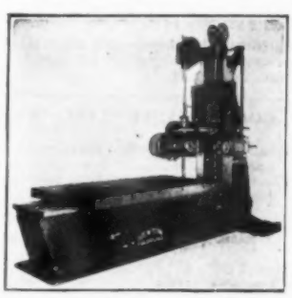
"American Machinist," July 29, 1920

The burner is designed to burn oxy-hydrocarbon-gas that it automatically produces from oil and water. Superheated steam is generated by the burner and combined with the oil flow as it leaves the nozzle. The hydrogen of the steam unites with the hydrogen and carbon of the oil, while the oxygen set free in a superheated state, is said to create perfect combustion when the torch is ignited. The correct mixture of oil and steam, also the proper degree of heat is obtained by manipulating the two needle valves at the top, the lower valve being provided merely as a blow-off. The burner will operate in any position and is designed to consume either the cheapest distillates or refined oils but not gasoline or kindred products.

Milling Machine, Newton Special

Newton Machine Tool Co., Inc., 23d and Vine Sts., Philadelphia, Pa. "American Machinist," July 29, 1920

The machine was designed for milling slots in motor rotors. The spindle is driven by a phosphor-bronze worm-wheel, and hardened steel worm, the worm having roller thrust-bearings and running in a bath of oil. The spindle is hollow to accommodate a draw-in-rod and the spindle nose has a Morse taper hole and a face keyway. The spindle saddle is counterweighted and has power rapid traverse in both directions, a safety feed stop being provided so that the downward rapid traverse cannot be careslessly engaged to the injury of cutters or work. Specifications: Feed of spindle saddle, 24 in. Maximum distance center of spindle to top of table, 24 in. Side adjustment of spindle, 2 in. Center of spindle to face of upright, 12 in. Work table, 54 x 96 in.



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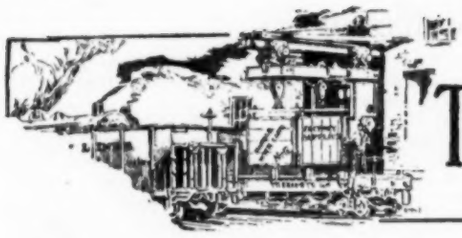


THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	41.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.12@8.00	4.57	8.10	7.02
No. 12	3.60-7.05	7.17@8.05	4.57	8.15	7.07
No. 14	3.65-7.10	7.22@8.10	4.67	8.20	7.12
No. 16	3.75-7.20	7.32@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20-6.20	8.30@9.80	5.30	8.70	7.80
Nos. 22 and 24	4.25-6.25	8.35@9.85	5.35	8.75	7.85
No. 26	4.30-6.30	8.40@9.90	5.40	8.80	7.90
No. 28	4.35-6.35	8.50@10.00	5.50	8.90	8.00
Galvanized					
No. 10	4.70-8.00	8.80@11.00	6.20	9.00	8.15
No. 12	4.80-8.10	8.90@11.00	6.25	9.10	8.20
No. 14	4.80-8.10	8.90@11.10	6.30	9.10	8.35
Nos. 18 and 20	5.10-8.40	9.15@11.40	6.60	9.40	8.65
Nos. 22 and 24	5.25-8.55	9.30@11.55	6.75	9.55	9.05
No. 26	5.40-8.70	9.45@11.70	6.90	9.70	9.20
No. 28	5.70-9.00	9.75@12.00	7.20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Prices in New York, in cents per pound:

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	42
Hot rolled copper nickel rods (base)	52
Manganese nickel hot rolled (base) rods "D" — low manganese	64
Manganese nickel hot rolled (base) rods "D" — high manganese	67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛ to 3	54-57½%	41½-44%	⅛ to 1¼	24½-34½%	8 -18½%
LAP WELD					
2	47 -50½%	34½-38%	1¼	....	....
2½ to 6	50 -53½%	37½-41%	1½	....	....
7 to 12	47 -50½%	33½-37%	2	20½-28½%	6½-14½%
13 to 14	37½-41 %	....	2½ to 6	22½-30½%	9½-17½%
15	35 -38½%	....	7 to 12	19½-27½%	6½-14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛ to 1¼	52 -55½%	39½-43%	⅛ to 1¼	24½-34½%	9½-19½%
2 to 3	53 -56½%	40½-44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 -48½%	33½-37%	1¼	....	....
2½ to 4	48 -51½%	36½-40%	1½	....	....
4½ to 6	47 -50½%	35½-39%	2	21½-29½%	8½-16½%
7 to 8	43 -46½%	29½-33%	2½ to 4	23½-31½%	11½-19½%
9 to 12	38 -41½%	24½-28%	4½ to 6	22½-30½%	10½-18½%
			7 to 8	14½-22½%	2½-10½%
			9 to 12	9½-17½%	5½-+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	49.00	61.50	70.00
Lead	9.25	9.00	5.50
Zinc	8.05	8.70	8.00
ST. LOUIS			
Lead	8.90	8.87½	5.25
Zinc	7.70@8.40	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

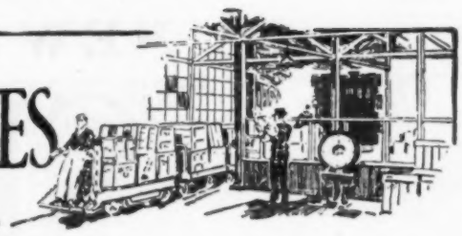
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	29.50	32.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	29.50	29.50	27.00	25.00
Brass sheets	28.50	28.50	23.00	29.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	35.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	26.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 12.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50	8.37½
Chicago	7.75	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.25	16.75	15.50	15.50
Copper, heavy, and wire	15.25	15.75	15.00	15.00
Copper, light, and bottoms	13.00	13.50	13.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.50
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	10.00	11.00	15.50
Brass, light	7.75–8.00	8.00	8.00	9.50
No. 1 yellow brass turnings	9.00–9.50	9.00	8.50	9.50
Zinc	5.25	4.25	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	33.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	61.00	80.00	60.00	75.00
Commercial	50.00	50.50	21.00	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$3.25	$ .50	$2.25	List	1.05
Hot pressed hexagon	+ 6.00	2.70	.50	2.25	List	.85
Cold punched hexagon	+ 6.00	3.25	.50	2.25	List	1.00
Cold punched square	+ 6.00	2.70	.50	2.25	List	1.00

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.50 Chicago..... $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	35%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ¾, ⅞, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.50

Structural, same sizes:
New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add 15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.75	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@19.00	18.00@19.00	16.00@17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	— New York —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.48	$2.15	$1.67	$2.53
5-gal. cans (without cans)	1.51*	2.28	1.92	2.73

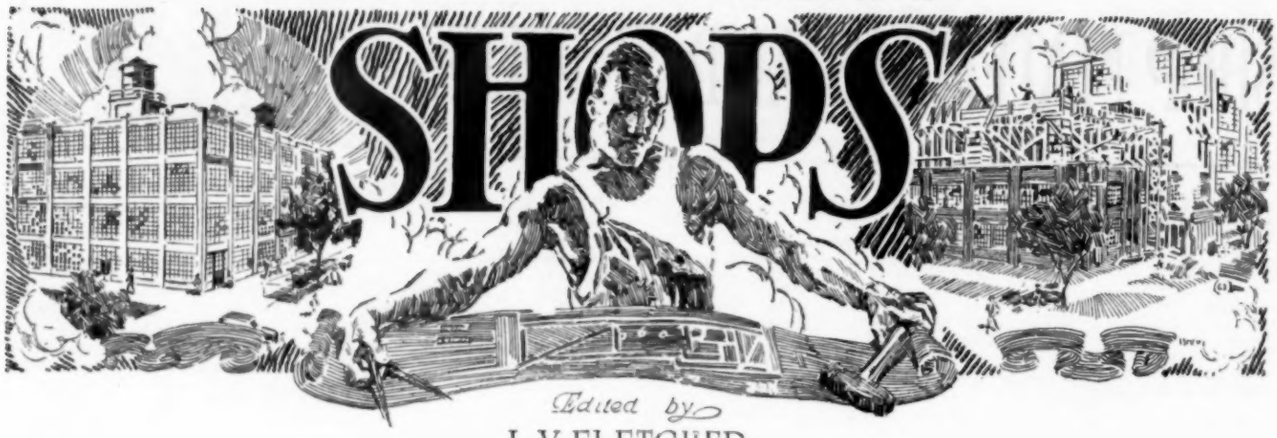
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Conn., Shelton—P. H. Martin, 62 Union St.—one engine lathe with about 10 in. swing (used preferred).

Md., Baltimore — The Baltimore & Ohio Ry., Baltimore and Charles Sts.—planers.

Md., Baltimore — The Maryland Motor Corp., 631 Munsey Bldg.—10 piston lathes, 3 duplex milling machines, grinders, 3 multi-spindle high speed drill presses and 3 heavy duty drill presses.

N. Y., New York (Borough of Brooklyn) —The Ideal Clamp Mfg. Co., 200 Bradford St.—one 6 in. stroke geared power press (new).

N. Y., New York (Borough of Manhattan) —The Milholland Machine Co., Room 602, 111 Bway., A. Brown, Purch. Agt.—
Three 23 x 8 in. bed engine lathes.
One 32 in. crank shaper.
One 40 in. x 10 in. bed engine lathe.
Three 42 in. vertical boring mills.
One 36 in. throat double end punch and shear.
One 2 in. single head bolt cutter.
One 24 in. drill press.
One 32 in. draw out shaper.
Two 24 in. x 10 ft. bed engine lathes.
Two 1½ in., four spindle bolt cutters.
One 3 spindle, independent feed drill.
One 20 in. x 8 ft. bed engine lathe.
One 2 head rod drill press.
One 36 in. cold saw.
One combined horizontal and vertical milling machine.

Pa., Philadelphia — The Acme Gear Co., 7th and Wood Sts.—complete draw-in attachment, range ⅜ to ¾ in. inclined by 16ths.

Pa., Philadelphia—M. J. Dougherty, 1618 Washington Ave.—general line of machine tools.

Pa., Philadelphia—T. H. Livezey & Co., 1215 Filbert St.—one 24 in. x 20 ft. engine lathe (new).

Pa., Philadelphia — The Tabor Mfg. Co., Tacony St.—one 1,200 lb. power hammer.

Ala., Mobile—The Kelly Dry Dock and Shipbuilding Co.—equipment for ship repair plant (new) with either 240 v. or 110 v. 3 ph. a.c. motor drive or belt drive.

Tenn., Memphis—The Kayne & Bowler Co.—one 5 ft. radial drill.

Va., Richmond — C. C. Josephus, Laurel and Broad Sts.—welding and other machinery for repair work.

Va., Richmond—The Seventh St. Garage Co., Inc., 7th and Leigh Sts., J. B. Blackburn, Purch. Agt.—complete equipment for repair work.

Va., Richmond—The Stutz Motor Co., 1800 West Broad St., J. R. Pope, Purch. Agt.—complete equipment for repairing motor cars.

Ill., Alton—The Gillespie Eden Corp.—one Natco 20 spindle rectangular head radial drill (new).

Ill., Chicago—The Mercory Mfg. Co., 4118 South Halsted St.—one 12 spindle adjustable drilling machine, 18 x 24.

Ill., Chicago — The M. Metzger Co., 209 South Green St., one horning press.

Ill., Dixon—The Reynolds Wire Co.—one 32 or 36 in. swing engine lathe, short bed, hollow spindle attachment, also one boring mill with 36 in. swing.

Mich., Detroit—The Ajax Pattern Wks., 133 Fort St.—pattern working equipment.

Mich., Detroit—The Barnes Pattern and Machine Co., 995 Gratiot Ave.—miscellaneous equipment.

Mich., Detroit—The Bell Pump and Mfg. Co., 74 East Fort St.—miscellaneous equipment for manufacture of pumps, including ⅜ in. cold roll rounds 20½ in. or longer.

Mich., Detroit—P. Leamiller, 373 Clay Ave.—one small foot power lathe similar to Barnes 4½ (new or used).

O., Cleveland—The Amer. Tube and Pipe Bending Co., Cuyahoga and Mahoning Aves. —one 4 or 6 in. pipe cutting and threading machine with reaming attachment, two 2 in. pipe threading machines, single or double head, with reaming attachment, one 3 in. pipe cut off machine and two high speed power cold saws, capacity up to 6 in pipe (new or used), either 220 v. d.c. motor drive or belt drive.

O., Columbus—The Columbus Anvil and Forging Co., 117 West Frankford St.—one No. 4 Brown & Sharpe grinding machine (new).

O., Columbus—The Norris Mfg. Co., 1424 East Cherry St., G. E. Norris, Purch. Agt.—drill press, shaper and other machinery.

O., Columbus—The Standard E. Z. Rim Co., 630 Columbus Savings and Trust Bldg., J. F. Devers, Purch. Agt.—one drill, one punching machine and one band saw.

O., Springfield—The Springfield Advance Machine Co.—one 500 to 10,000 lb. board drop hammer (used).

Wis., Milwaukee—I. H. Diehal, 1538 Hopkins St.—one 16 in. jointer and one pony planer.

Wis., Milwaukee—The Heil Co., 26th and Montana Aves., H. Winton, Purch. Agt.—one 12 ft. power brake for ⅜ in. material, punch for punching 1 in. hole in ½ in. material, and ⅜ in. gate shear.

Wis., Milwaukee—The Holm Radiator Co., 228 3d St., H. H. Holm, Purch. Agt.—power shears and punch presses.

Wis., North Milwaukee—P. S. Sorenson, 327 Western Ave.—one planer and one resaw.

Wis., Two Rivers—The Bd. Educ.—machine shop equipment.

Kan., Kansas City — The Kansas City Boiler Works Co., 14 Garfield Ave.—cranes, punches, shears, rolls, lathes, drill presses, boring mill and benders.

Minn., Duluth — The Marshall Wells Co., Lake Ave., S.—one 75 lb. and one 100 lb. Bradley strap hammer (new).

Minn., Minneapolis—The Bd. Educ., 305 City Hall, K. E. Alexander, Purch. Agt.—
Standard grade and high school machine tool equipment for September, 1920, term, $9,800, including belt lacing machine, gear and angle cutters of various sizes, miscellaneous types and numbers of hand, automatic and twist drills, face plates for Oliver lathe, gauges, grinder wheels, lathe chuck, reamers, saws, threading tools, threading tool cutters, side tool cutters, cut-off tool cutters, extension shaper tools, vises, etc.
New machine shop equipment for Bremer junior high school, $3,500.
Equipment for North high school for study of gas engines, $3,000.
Items of machinery to enlarge equipment in various shops already established in high schools, $17,200.

Minn., Minneapolis—The A. C. Dunn Mfg. Co., 1118 3d Ave., S.—circle shears.

Minn., Minneapolis — The Natl. Machine and Tool Co., 249 3d Ave., O. H. Thomas, Purch. Agt.—one No. 3 punch press, Consolidated or American Can Co., and one light 4 spindle drill press (used).

Mo., St. Louis—The Beall Pressed Steel Co., 4500 North 2d St.—
One punch press, 12 in. throat, capacity 2½ in. hole in 1½ in. sheet.
Several Ferracute No. 2P or 3P punch presses (or similar).
One rotary shear for ½ in. mild steel (all new).

Mo., St. Louis — The Steiner Mfg. Co., 4100 North 21st St.—one 18 x 24, 12 spindle, adjustable drilling machine, capacity up to ⅝ in.

Tex., Houston—The Kreiter Machine Co., 205 San Jacinto St.—two Heald, Landis or Brown & Sharpe grinding machines (used).

Cal., San Francisco—The Berger & Carter Co., 365 Market St.—one 1½ in. triple head bolt cutting and threading machine.

Ont., Toronto — The Canadian National Railways, E. Langham, Purch. Agt.—
One 80 in. drive wheel lathe, motor drive.
One 34 in. x 12 in. gap lathe.
One 24 in. x 12 ft. engine lathe.
One 24 in. shaping machine.
One 36 in. upright drill.
One 1,000 lb. steam hammer.
One 36 in. x 8 ft. planer.
One cast iron car wheel boring machine.
One car wheel hydraulic press, motor drive.
One double end car wheel axle lathe.
One triple head bolt threading machine (all new or used).

Ont., Toronto—The A. R. Williams Co., 64 Front St.—one 2 in. triple head bolt threading machine.

Machinery

The following concerns are in the market for machinery:

N. J., Newark—A. W. Moore, 22 Green St.—small pneumatic core making machines for automobile cylinders and Mumford, Grimes, Pridmore or Tabor pneumatic roll-over molding machines to jar and roll over 1,500 to 2,000 pounds.

N. Y., East Syracuse—The Benedict Mfg. Co., W. J. Hanlon, Purch. Agt.—machine for grinding knives.

N. Y., Syracuse—The Syracuse Washing Machine Corp., 507 East Water St., H. C. Cock, Purch. Agt.—nickel plating and galvanizing machine.

N. C., Greensboro—H. B. Worth—woodturning lathes and miscellaneous equipment for manufacture of handles.

Ill., Chicago—D. Levi & Co., West 40th St. and Packers Ave.—packing house equipment.

Ill., Peoria—The Rueckheim Bros. & Erkstein—special box dies with ½ in. steel cutting and creasing blades for manufacture of cardboard boxes.

O., Columbus — The Franklin Brick and Tile Co., Columbus Savings and Trust Bldg., R. S. Dingledive, Purch. Agt.—brick making machinery.

O., Columbus—The Williams Milling Co., Columbia Bldg., J. B. Wolf, Purch. Agt.—machinery for flour mill.

Wis., Milwaukee—J. Mahler, 2621 Lisbon Ave.—one baling machine.

Wis., Milwaukee—Water Dept., City Hall, F. J. Murphy, Purch. Agt.—one ton crane.

Wis., Stevens Point—The Piffner Lumber Co., 225 Franklin St.—woodworking machinery.

Ark., Little Rock — E. L. Bruce, East 17th St.—one automatic glue jointer.

Ont., St. Thomas — The Canada Iron Fdry., S. Gilbert, Mgr.—iron working machinery.

Que., Montreal—The L. R. Steel Co., Ltd.—woodworking equipment.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—A. Aldo, 1699 Madison Ave., will soon award the contract for the construction of a 1 story, 100 x 110 ft. garage, on North Ave. and Sedswick St. Estimated cost, $50,000. F. A. Cooper, 1024 Main St., Archt. Noted Aug. 5.

Conn., Bridgeport—H. H. McCathron, 72 Knowlton St., will build a 1 story, 60 x 220 ft. forge plant, for the manufacture of boilers, etc. Estimated cost, $20,000.

Conn., Hartford—The Frasse Steel Corp., 45 Boulevard, has awarded the contract for the construction of a 1 story, 35 x 105 ft. addition to its factory. Estimated cost, $25,000. Noted April 15.

Conn., Hartford — A. Goldstein, Maple Ave., will soon award the contract for the construction of a 1 story, 110 x 150 ft. garage. Estimated cost, $100,000. F. C. Walz, 407 Trumbull St., Archt. Noted Jan. 29.

Conn., Hartford—Ryan & Delaney, c/o J. C. Walz, Archt., 407 Trumbull St., will soon award the contract for altering present building and constructing a 1 story, 65 x 190 ft. garage on High St. Estimated cost, $35,000.

Conn., New Haven—The Capitol Garage, 168 Columbus Ave., will build a 1 story, 35 x 80 ft. addition to its garage. Estimated cost, $10,000.

Conn., New Haven—The Fritzell Brass Fdry. Co., 33 Chestnut St., has acquired the plant of the International Leather and Belting Corp., on Middletown Ave., and plans to remodel same for its own use. Fletcher Thompson, Inc., 1089 Broad St., Bridgeport, Engrs. and Archts.

Mass., Chelsea—M. Rosenthal, 64 Hawthorn St., will build a 1 story, 65 x 130 ft. garage on Essex St. Estimated cost, $35,000.

Mass., Everett — The National Garage, School St., has awarded the contract for the construction of a 1 story, 60 x 120 ft. garage on Boulevard. Estimated cost, $25,000.

Mass., Gardner—The Central Oil & Gas Stove Co. has awarded the contract for the construction of a 3 story, 65 x 150 ft. factory on Plant St.

Mass., Malden—I. Meyer, 2 Irving St., has awarded the contract for the construction of a 1 story, 70 x 150 ft. garage on Eastern Ave. and Ferry St. Estimated cost, $25,000.

Mass., Methuen—R. Webb is having plans prepared for a 1 story garage on Lowell and Arnold Sts. Estimated cost, $20,000. Private plans.

Mass., Springfield — The Wallace Realty Trust Co., 392 Main St., has awarded the contract for altering and building a 1 story, 35 x 80 ft. addition to its garage on Water St., also altering its boiler house on Pynchon St. Estimated cost, $26,500.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Boyden Steel Corp., Keyser Bldg., has been incorporated with $100,000,000 capital stock and plans to build a plant for the manufacture of railroad equipment trucks, etc. G. A. Boyden, R. Ramsay, Keiper Bldg., and T. G. Lurman, 808 St. Paul St., directors.

N. J., Edgewater — The United States Aluminum Co. plans to build a large addition to its plant.

N. J., Jersey City—J. T. Ryerson & Sons, 230 West Side Ave., manufacturers of steel, plan to build an addition to their plant. Estimated cost, $50,000.

N. J., Trenton—The Mueller Machine Co., Ward Ave., manufacturer of clay, tile and linoleum machinery, is having plans prepared by N. A. K. Bugbee Co., Engrs., 206 Hanover St., for the construction of a 1 story, 100 x 200 ft. machine shop and a 2 story, 50 x 100 ft. office building. Estimated cost, $40,000.

N. Y., Jamestown—The Jamestown Malleable Iron Products Corp., 306 Fenton Bldg., will receive bids until August 16 for the construction of a 2 story, 290 x 300 ft. plant for the manufacture of malleable iron castings. A. E. Schobeck, Secy.

N. Y., New York (Borough of Brooklyn)—The Brownsville Assets Corp., c/o P. Steigman, 690 Bway., Brooklyn., will build a 1 story, 100 x 160 ft. garage at 150 Crescent St. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—J. Schkelnick, 37 Van Buren St., will build a 1 story, 100 x 100 ft. garage on Moore St. Estimated cost, $60,000.

N. Y., New York (Borough of Bronx)—A. Camp, c/o Dunnigan & Crumley, Archts., 394 East 150th St., will build a 1 story, 50 x 100 ft. garage on Fordham Rd. Estimated cost, $38,000.

N. Y., New York (Borough of Manhattan)—M. Miller, 935 Intervale Ave., will build a 1 story, 100 x 135 ft. garage on Park Ave. and 184th St. Estimated cost, $60,000.

N. Y., New York—The S. & Z. Bldg. Co., c/o J. M. Felson, Archt., 1133 Bway., will build a 3 story garage and service station on Manhattan Ave. and 130th St. Estimated cost, $120,000.

N. Y., New York (Borough of Manhattan)—S. Varschleisser, 215 East 67th St., will build a 1 story garage. Estimated cost, $50,000. Noted July 1.

Pa., New Castle — The Johnson Bronze Co., South Mill St., will soon award the contract for the construction of a 2 story, 52 x 68 ft. core building, a 2 story, 32 x 62 ft. machine shop and a 1 story, 68 x 101 ft. foundry. Estimated cost, $125,000. E. D. Chase, 645 North Michigan St., Chicago, Ill., Archt.

Pa., Philadelphia—The Blumenthal Bros., Margaret and James Sts., have awarded the contract for the construction of a 1 story, 60 x 100 ft. garage and machine shop. Estimated cost, $20,000. Noted Aug. 5.

Pa., Philadelphia—The Hulburt Oil and Grease Co., Inc., Trenton and Erie Sts., has awarded the contract for the construction of a 2 story, 45 x 90 ft. repair shop.

Pa., Philadelphia — The McCraffrey File Co., 5th and Berks Sts., will soon award the contract for the construction of a 2 story, 80 x 80 ft. garage. Estimated cost, $20,000. Private plans.

Pa., Philadelphia—The Quaker City Cab Co., 1211 Vine St., is having plans prepared for the construction of a 1 story, 90 x 140 ft. garage on Vine and 12th Sts. Estimated cost, $15,000. J. Sauer & Co., Denckla Bldg., Engrs. and Archts.

Pa., Philadelphia—G. Shear, 549 South Redfield St., has awarded the contract for the construction of a 1 story, 40 x 225 ft. and 40 x 110 ft. garage at 6028 Pine St. Estimated cost, $23,000.

SOUTHERN STATES

Ga., Atlanta — The Red Diamond Motor Corp. has awarded the contract for the construction of an assembling plant. Estimated cost, $300,000.

MIDDLE WEST

Ill., Chicago—A. Fesel, c/o J. K. Neebe, Archt., 2522 Aubert Ave., will soon award the contract for the construction of a 1 and 2 story, 100 x 108 ft. garage on Western St. near Montrose St. Estimated cost, $75,000.

Ill., Chicago—A. P. Freeman, c/o Levy & Klein, Archts., 111 West Washington St., has awarded the contract for the construction of a 1 story, 85 x 115 ft. garage at 23-29 North May St. Estimated cost, $35,000.

Ill., Chicago—The Independent State Garage, Kedzie and Grenshaw Sts., will soon award the contract for the construction of a 1 story, 100 x 175 ft. garage on Madison and Keeler Sts. Estimated cost, $65,000. A. Himmelblau, 179 West Washington St., Archt.

Ill., Chicago—The Kipps Express & Van Co., 6436 South Ashland St., has awarded the contract for the construction of a 1 story, 100 x 123 ft. garage at 6436 South Ashland St. Estimated cost, $25,000.

Ill., Evanston (Chicago Station)—The Buick Motor Co., c/o A. Sandegren, Archt., 25 North Dearborn St., Chicago, has awarded the contract for the construction of a 1 story, 50 x 120 ft. garage on Davis and Oak Sts. here. Estimated cost, $25,000.

Mich., Detroit — The Detroit Insulated Wire Co., Wesson and Albert Sts., has awarded the contract for the construction of a 3 story, 40 x 80 ft. factory and office building. Estimated cost, $80,000.

Mich., Detroit — The Wood Hydraulic Hoist & Body Co., 1789 Warwick Ave., has awarded the contract for the construction of a 2 story, 140 x 400 ft. factory. Noted June 17.

Mich., Detroit — The Zenith Carburetor Co., Hart Ave., will soon award the contract for the construction of a 2 story, 60 x 117 ft. factory. Estimated cost, $70,000. Smith, Hinchman & Grylls, 710 Washington Arcade, Engrs.

O., Akron—The United Machine and Mfg. Co. has had preliminary plans prepared for a 100 x 200 ft. foundry. Estimated cost, $100,000. L. E. Griffith, Pres.

O., Alliance—The Transue Williams Co., manufacturer of steel forgings, has awarded the contract for the construction of a 1 story, 100 x 200 ft. factory. Estimated cost, $75,000.

O., Cleveland—The Baker Rauch & Lange Co., 2180 West 25th St., manufacturers of electric vehicles, will soon award the contract for the construction of a 4 story, 64 x 110 ft. factory on West 25th St. and Chatham Ave. Estimated cost, $100,000. G. S. Rider & Co., Century Bldg., Archts.

O., Cleveland—The Cleveland Hardware Co., East 49th St. and Lakeside Ave., has awarded the contract for the construction of a 1 story, 49 x 197 ft. garage on East 80th St. and Averna Ave. Estimated cost, $40,000.

O., Cleveland — The Cleveland Wrought Products Co., 3590 West 58th St., has awarded the contract for the construction of a 1 story, 56 x 145 ft. factory. Estimated cost, $50,000.

O., Cleveland—The Cuyahoga Sheet Metal Co., 7908 Quincy Ave., has awarded the contract for the construction of a 1 story, 34 x 60 ft. factory. Estimated cost, $12,000.

O., Cleveland—The Exide Battery Co., 5125 Perkins Ave., has awarded the contract for the construction of a 2 story addition to its factory. Estimated cost, $60,000.

O., Cleveland — The Kaynee Co., 6925 Aetna Rd., will soon award the contract for the construction of a 1 story, 60 x 180 ft. box factory and garage, on Aetna Rd. and Bway. Estimated cost, $60,000. E. C. Seitz, Treas. Lockwood, Green & Co., Bangor Bldg., Cleveland, Engrs. and Archts.

O., Cleveland—The Ohio Electric Controller Co., 5900 Maurice Ave., has awarded the contract for the construction of a 2 story, 38 x 110 ft. addition to its factory. Estimated cost, $60,000.

O., Cleveland — The Republic Electric Mfg. Co., 1820 East 18th St., will soon award the contract for the construction of a 3 story, 50 x 50 ft. factory and 50 x 50 ft. office building, on East 18th St. and Chester Ave. Estimated cost, $100,000. L. Griesser, Pres. J. M. Dyer, Amer. Trust Bldg., Archt.

O., Cleveland—The U. S. Molding Machine Co., 968 East 69th St., plans to build a 1 story addition to its factory. Estimated cost, $50,000.

O., Cleveland—The West Steel Castings Co., 805 East 70th St., has awarded the contract for the construction of a 1 story, 20 x 71 ft. garage. Estimated cost, $10,000.

O., East Cleveland (Cleveland P. O.)—The Electric Vacuum Cleaner Co., Ivanhoe Rd., has awarded the contract for the construction of a 1 story, 65 x 80 ft. factory. Estimated cost, $25,000. Noted April 15.

O., East Cleveland (Cleveland P. O.)—The Shield Bldg. Co., 1753 Doan Ave., is preparing plans for the construction of a 1 story, 100 x 100 ft. commercial building and garage on Euclid and Superior Aves. Estimated cost, $30,000. Private plans.

Wis., Cudahy — The Worthington Pump and Mchy. Co. will soon award the contract for the construction of a 3 story, 60 x 170 ft. pattern shop.

Wis., Milwaukee—S. Buchbinder, 545 Van Buren St., has awarded the contract for the construction of a 1 story, 65 x 70 ft. garage on Martin St. Estimated cost, $15,000. Noted July 29.

Wis., Milwaukee—The H. N. Davis Co., 129 Michigan St., will soon award the contract for the construction of a 2 story, 60 x 110 ft. factory on 32d St. for plating and polishing.

Wis., Milwaukee—The Ford Motor Co., Blvd. and Woodward St., Detroit, Mich., plans to build a 2 story, 60 x 150 ft. addition to its assembling plant on Kenilworth St. here.

Wis., Milwaukee — The Kickhaefer Mfg. Co., 201 Oregon St., is building a 1 story, 60 x 142 ft. factory on Reed St. for metal stamping. Estimated cost, $45,000.

Wis., Milwaukee—The A. E. Martin Fdry. and Machine Co., 705 Park St., will soon award the contract for the construction of a 1 story, 30 x 145 ft. addition to its foundry. S. F. Kadow, 97 Wisconsin St., Archt.

Wis., Neillsville — The Duplex Storage Battery Co., 537 Edison St., Milwaukee, will soon award the contract for the construction of a 1 story, 100 x 300 ft. factory here.

Wis., North Milwaukee — The Bernert Mfg. Co., 489 12th St., has awarded the contract for the construction of a 1 story, 60 x 120 ft. foundry. Noted May 27.

Wis., Plymouth — The Service Motor Co. plans to build a 4 story, 60 x 200 ft. garage. Estimated cost, $100,000.

Wis., Two Rivers — The Bd. Educ. will soon award the contract for the construction of a 3 story, 144 x 199 ft. high school to include a machine shop and power house. Estimated cost, $400,000.

Wis., West Milwaukee (Milwaukee P. O.)—The Chicago, Milwaukee and St. Paul Ry., Construction Dept., Union Depot, is preparing plans for the construction of a 1 story, 100 x 500 ft. shop for repairing cars.

WEST OF THE MISSISSIPPI

Iowa, Davenport — G. A. Koester, c/o Davenport Roofing Co., has awarded the contract for the construction of a 3 story, 65 x 150 ft. garage on Front St. Estimated cost, $150,000.

Kan., Kansas City — The Kansas City Boiler Works Co., 14 Garfield Ave., is building a 1 story, 40 x 60 ft. and 40 x 198 ft. plant. Estimated cost, $40,000. E. L. Hudson, Genl. Mgr.

Mo., Monett—The St. Louis & San Francisco Ry., Frisco Bldg., St. Louis, has awarded the contract for the construction of a 1 story, 16 x 72 x 110 ft. machine shop and a 16 x 27 x 80 ft. roundhouse. Estimated cost, $40,000.

Mo., Newburg—St. Louis & San Fransico Ry., Frisco Bldg., St. Louis, has awarded the contract for the construction of a 1 story, 16 x 27 x 110 ft. roundhouse and a 16 x 27 x 80 ft. machine shop. Estimated cost, $40,000.

Mo., St. Louis—The F. Adams Electric Co., 3640 Winsor St., has awarded the contract for the construction of a 1 story, 147 x 190 ft. factory. Estimated cost, $150,000.

Mo., St. Louis—The Brecht Co., 1201 Cass Ave., has awarded the contract for the construction of a 2 story, 107 x 130 ft. machine shop. Estimated cost, $80,000.

Mo., St. Louis—The Eagle Motor Truck Corp., 6154 Bartmer Ave., plans to build an additon to its plant.

Mo., St. Louis—The Heine Safety Boiler Co., 5319 Marcus Ave., has awarded the contract for the construction of a 1 story factory. Estimated cost, $25,000.

Mo., St. Louis—The Landes Machine Co., 407 Gano St., has awarded the contract for the construction of a 1 story boiler and machine shop at 4929-31 North 2nd St. Estimated cost, $6,000.

Mo., St. Louis — The Urbauer Atwood Heating Co., 1446-50 South 2d St., has awarded the contract for the construction of a 2 story, 60 x 108 ft. factory. Estimated cost, $12,000.

Tex., Beaumont — The Oil City Brass Wks. is building a 90 x 200 ft. foundry and machine shop. Estimated cost, $25,000.

CANADA

Ont., Hamilton—The Steel Works of Canada, Harvey Lane, will soon award the contract for the construction of a 2 story steel plant and foundry. Estimated cost, $300,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport — The Amer. Fabrics Corp., Connecticut Ave. and Waterman St., will soon award the contract for the construction of a 1 story, 60 x 166 ft. factory, for the manufacture of lace. Estimated cost, $50,000.

Conn., Hartford — The Home Tourist Candy Co., c/o Backoff, Jones & Cook, Archts., Union Bldg., Newark, N. J., will soon award the contract for the construction of a 2 story, 60 x 100 ft. factory. Estimated cost, $50,000. Noted June 3.

Conn., Naugatuck—The Naugatuck Chemical Co., Elm St., has awarded the contract for the construction of a 2 story, 50 x 60 ft. factory for the manufacture of mineral flour, on Elm St. Estimated cost, $60,000.

Mass., Wakefield—The Heywood Bros. & Wakefield Co., Gardner, Mass., manufacturers of chairs, will soon award the contract for the construction of 6 dry kiln buildings and an addition to its plant here. Lee & Hewitt, 1123 Bway., New York City, Archts.

R. I., East Greenwich—The Greenwich Mills, Division St., will soon award the contract for the construction of a 4 story, 80 x 90 ft. addition to its textile plant. Estimated cost, $50,000. Noted Aug. 5.

MIDDLE ATLANTIC STATES

N. J., Jersey City—The Cotton Textile Co., 383-385 Cator Ave., plans to construct 4 factory buildings. Estimated cost, $50,000.

N. J., Trenton — The Hamilton Rubber Mfg. Co., Mead St., has awarded the contract for the construction of a 2 story, 20 x 40 ft. addition to its factory, for the manufacture of tires. Estimated cost, $15,000.

N. J., Trenton — The Thermoid Rubber Co., Whitehead Rd., has awarded the contract for the construction of a 1 story, 80 x 200 ft. addition to its new plant. Estimated cost, $50,000.

Pa., Coraopolis—The Domestic Refrigerating Co. will soon award the contract for the construction of a 1½ story, 60 x 100 ft. factory. Estimated cost, $40,000. The Brandt Clapper Co., Park Bldg., Pittsburgh, Archts.

Pa., Philadelphia—The Keystone Spinning Mills, 1631 North 2nd St., has awarded the contract for altering its plant and building a 2 story, 60 x 95 ft. warehouse, on Turner and Palethorpe Sts.

MIDDLE WEST STATES

Ill., Chicago—The F. H. Hill Co., Washington and Morgan Sts., manufacturer of coffins, has had plans prepared by Waltersdorf & Bernard, Archts., 38 North La Salle St., for the construction of a 7 story, 34 x 88 ft. factory. Estimated cost, $75,000.

Ill., Chicago—D. Levi & Co., West 40th St. and Packers Ave., has awarded the contract for the construction of a 3 story, 115 x 170 ft. packing plant, on West 39th St. and Emerald Ave. Estimated cost, $350,000.

Wis., Campbellsport — The White House Milk Products Co., West Bend, is having plans prepared by M. Tullgren & Sons, Archts., 425 East Water St., Milwaukee, for a 1 story, 50 x 100 ft. plant.

Wis., Rice Lake—The Twentieth Century Silo Co. is planning to build a stave mill on Bracklin St. and Kern Ave. A. C. Robarge, Secy.

Wis., Sheboygan—The Columbia Rubber Works, 176 16th St., Milwaukee, plans to remodel and build an addition to its factory. Estimated cost, $100,000. Juul & Smith, 805 North 8th St., Archts.

WEST OF THE MISSISSIPPI

Minn., Minneapolis—Roach Tisdale & Co., 528 North 3d St., is planning to build a 5 story, 50 x 150 ft. factory on 5th Ave. and 3d St. for the manufacture of candy. Estimated cost, $200,000. E. E. Tisdale, Secy., Butler Bros. Bldg. Co., 1001 Exchange Bank Bldg., St. Paul, Archts.

Mo., Kansas City — The Feeder Supply Co., 532 Live Stock Exchange Bldg., has purchased a site on Duncan Ave. and plans to build a mill. Estimated cost, $150,000.

Mo., Kansas City—The Irving Pitt Mfg. Co., 8th and Locust Sts., is building a 6 story, 132 x 132 ft. factory for the manufacture of loose leaf binders. Estimated cost, $500,000.

Mo., St. Louis—The Schulz Belting Co., 4th and Boston Sts., has awarded the contract for the construction of a 1 story, 25 x 50 ft. factory, on South 4th St. Estimated cost, $6,000.

CANADA

Ont., Grimsby—The Grimsby Pickle Co. will soon award the contract for the construction of a 3 story, 40 x 80 ft. factory. Estimated cost, $40,000.

Que., Montreal—The L. R. Steel Co. Ltd., will soon award the contract for the construction of a woodworking plant.

FOREIGN

Alaska, Unalaska Island — The Amer. Whale Products Co., 8 South Dearborn St., Chicago, Ill., will soon award the contract for the construction of a whale oil plant on Udagak Bay, here, to include refinery, fertilizer plant, oil tanks and storage buildings. Estimated cost, $1,000,000 Waltersdorf & Bernard, 138 North La Salle St., Chicago, Ill., Archts.

SEE SEARCHLIGHT SECTION

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